ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABUS

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (Internet of Things)

(Applicable for batches admitted from 2020-2021)

VASIREDDY VENKATADRI
INSTITUTE OF TECHNOLOGY

VASIREDDY VENKATADRI INSTITUTE OF TECHNOLOGY
(Autonomous)

Approved by AICTE, Permanently Affiliated to JNTUK,

NAAC Accredited with ‘A’ Grade, ISO 9001:2015 Certified

Nambur (V), Pedakakani (M), Guntur (Dt.), Andhra Pradesh – 522 508

ACADEMIC REGULATIONS (R20) FOR B. TECH.

(REGULAR/HONORS/MINOR)

Applicable for the students of B. Tech. (Regular) from the Academic Year 2020-21 onwards

The B.Tech Degree of Jawaharlal Nehru Technological University Kakinada, Kakinada shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

VISION

To impart quality education through exploration and experimentation and generate socially-conscious engineers, embedding ethics and values, for the advancement in science and technology.

MISSION

- To educate students with a practical approach to dovetail them to industry-needs.
- To govern the institution with a proactive and professional management with passionate teaching faculty.
- To provide holistic and integrated education and achieve over all development of students by imparting scientific and technical, social and cognitive, managerial and organizational skills.
- To compete with the best and be the most preferred institution of the studious and the scholarly.
- To forge strong relationships and linkage with the industry.

OBJECTIVES

- Equip the institute with state-of-the-art infrastructure comparable to the best in the industry.
- Tap the resources of the best minds in the field as faculty and visiting faculty.
- Groom students to become global entrepreneurs and responsible citizens.
- Provide financial assistance to meritorious students.
- Requisition the services of the best HR managers to place our students in reputed industries.
- Provide conducive atmosphere to the faculty for Research & Development and ensure active participation of the students.

DEPARTMENT VISION

To accomplish the aspirations of emerging engineers to attain global intelligence by obtaining computing and design abilities through communication that elevate them to meet the needs of industry, economy, society, environmental and global.

DEPARTMENT MISSION

- To mould the fresh minds into highly competent IoT application developers by enhancing their knowledge and skills in diverse hardware and software design aspects for covering technologies and multi-disciplinary engineering practices.
- To provide the sate- of- the art facilities to forge the students in industry-ready in IoT system development.
- To nurture the sense of creativity and innovation to adopt the socio-economic related activities.
- To promote collaboration with the reputed industries with a view to have best careers.
- To enable graduates to emerge as independent entrepreneurs and future leaders.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO-1: To formulate the engineering practitioners to solve industry's technological problems.

PEO-2: To engage the engineering professionals in technology development, deployment, and engineering system implementation.

PEO-3: To instil professional ethics, values, social awareness, and responsibility to emerging technology leaders.

PEO-4: To provide the technocrats the amicable environment for the successful pursuing of engineering and management.

PEO-5: To create right path to pursue their careers in teaching, research, and innovation.

PROGRAM OUTCOMES (POS)

PO1 : Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 : Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 : Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 : Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 : Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 : The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.

PO7 : Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 : Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 : Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 : Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 : Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO-1: Proficient and innovative with a strong cognizance in the arenas of sensors, IoT, data science, controllers, and signal processing through the application of acquired knowledge and skills.

PSO-2: Apply cutting-edge techniques and tools of sensing and computation to solve multi-disciplinary challenges in industry and society.

PSO-3: Exhibit independent and collaborative research with strategic planning while demonstrating professional and ethical responsibilities of the engineering profession.

ACADEMIC REGULATIONS (R20) FOR B. TECH. (REGULAR)

1. Award of B. Tech. Degree

A student will be declared eligible for the award of B. Tech. degree if he/she fulfils the following:

- Pursues a course of study in not less than four and not more than eight academic years.
- After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.
- Registers for 160 credits and must secure all the 160 credits.
- A student shall be eligible for the award of **B.Tech degree with Honors or Minor if he/she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.**

2. Courses of Study: The following courses of study are offered at present as specializations for the B. Tech. Courses

S. No.	Branch	Branch Short Form	Branch Code
1	Civil Engineering	CIV	01
2	Electrical and Electronics Engineering	EEE	02
3	Mechanical Engineering	MEC	03
4	Electronics and Communication Engineering	ECE	04
5	Computer Science and Engineering	CSE	05
6	Information Technology	INF	12
7	CSE (Artificial Intelligence and Machine Learning)	CSM	42
8	CSE (Internet of Things and Cyber Security including Block Chain Technology)	CIC	47

9	CSE (Internet of Things)	CSO	49
10	CSE (Artificial Intelligence and Data Science)	AID	54

3. **Medium of Instruction:** The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only.

4. **Admissions:** Admission to the B. Tech Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or on the basis of any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

5. **Structure of the Undergraduate Engineering program:** Every course of B. Tech. Program shall be placed in one of the nine categories as listed in table below:

S. No.	Category	Breakup of Credits
1	Humanities and social science including Management courses	10.5 - 12
2	Basic Science courses	21 - 25
3	Engineering science courses	24
4	Professional core Courses	48 - 51
5	Open Elective Courses	12 - 18
6	Professional Elective Courses	15 - 18
7	Internship, seminar, project wok	15 – 16.5
8	Mandatory courses	NC
9	Skill Oriented Courses	----
	Total Credits	160

** Breakup of Credits based on AICTE /APSCHE

Assigning of Credits

- Hr. Lecture (L) per week - 1 credit
- Hr. Tutorial (T) per week - 1 credit
- Hr. Practical (P) per week - 0.5 credits

6. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four (three for lateral entry) academic years

ii. Each Academic year of study is divided in to two semesters.

iii. Minimum number of instruction days in each semester is 90.

iv. Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).

v. The total credits for the Programme are 160.

vi. A three-week induction program is mandatory for all first year UG students (Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc.,) and shall be conducted as per AICTE/UGC/APSCHE guidelines.

vii. Student is introduced to "Choice Based Credit System (CBCS)."

viii. A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)

ix. A student has to register for all courses in a semester.

x. All the registered credits will be considered for the calculation of final CGPA.

xi. Each semester has - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.

xii. A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.

xiii. All students shall be mandatorily registered for NCC/NSS activities. A student will be required to participate in an activity for two hours in a week during second and third semesters. Grade shall be awarded as Satisfactory or Unsatisfactory in the mark sheet on the basis of participation, attendance, performance, and behaviour. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

xiv. Courses like Environmental Sciences, Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

xv. College shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies / GATE / other competitive exams etc.

xvi. Departments may swap some of the courses between first and second semesters to balance the work load.

xvii. The concerned Board of studies can assign tutorial hours to such courses wherever it is necessary, but without change in the total number of credits already assigned for semester.

7. Registration for Courses

i. The college shall invite registration forms from the students at the beginning of the semester for the registration for courses each semester. The registration process shall be closed within one week. If any student wishes to withdraw the registration, he/she shall submit a letter to the principal through the class teacher/instructor and HOD. The principal shall communicate the registration and withdraw details courses of each student in a consolidated form to the college examination section and University without fail.

ii. There are four open electives in each branch. All Open Electives are offered to students of all branches in general. A student shall choose an open elective, by consulting the HOD/advisor, from the list in such a manner that he/she has not studied the same course in any form during the Programme. The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

iii. A student shall be permitted to pursue up to a maximum of two elective courses under MOOCs during the programme. Students are advised to register for only for minimum 12 weeks in duration MOOCs courses. Student has to pursue and acquire a certificate for a MOOC course only from the SWAY/NPTE through online with the approved by the BoS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester. The details of the MOOCs courses registered by the students shall be submitted to the University examination center as well as college examination center. The Head of the Department shall appoint a mentor for each of the MOOC subjects registered by the students to monitor the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

iv. Two summer internships each with a minimum of six weeks duration shall be mandatorily done/completed respectively at the end of second and third years (during summer vacations). The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs. After completing the summer internship, the students shall register in the immediate respective odd semester and it will be evaluated at the end of the semester as per norms of the autonomy. The student has to produce the summer internship satisfactory report and certificate taken from the organization to be considered for evaluation. The College shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

v. In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

vi. Curricular Framework for Skill oriented courses

a. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.

b. For skill oriented/skill advanced course, one theory and 2 practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.

c. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining two shall be skill-advanced courses either from the same domain or job-oriented skill courses, which can be of inter disciplinary nature.

d. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HoD of the college.

e. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/ Professional bodies /APSSDC or any other accredited bodies. However, the department has to assign mentors in the college to monitor the performance of the students.

f. If a student chooses to take a certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the department, then the department shall mark overall attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency. The credits will be awarded to the student upon producing the successful course completion certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per BoS norms at the end of the semester.

8. Attendance Requirements:

i. A student is eligible to write the semester-end examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

ii. Shortage of Attendance below 65% in aggregate shall in NO case be condoned. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that class and their registration shall stand cancelled.

iii. Condonation for shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

iv. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

v. A student will be promoted to the next semester if he satisfies the(a) attendance requirement of the present semester and (b) minimum required credits (from Vth Semester onwards).

vi. If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

vii. For induction programme attendance shall be maintained as per AICTE norms.

viii. For non-credit mandatory courses the students shall maintain the attendance similar to credit courses.

9. Evaluation-Distribution and Weightage of marks

Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Academic Council of the institute from time to time.

i. A student is deemed to have satisfied the minimum academic requirements if he/she has earned the credits allotted to each theory/practical design/drawing subject/ project etc. by securing not less than 35% of marks in the end semester exam and minimum 40%

of marks in the total of the internal marks and end semester examination marks together.

ii. For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

iii. **Distribution and Weightage of marks:** The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The performance of a student in each semester shall be evaluated subject–wise with a maximum of 100 marks for theory subject, 50 marks for practical subject/Mini Project/Internship/Industrial Training/ Skill Development programmes /Research Project, and 200 marks for end Project Work.

iv. **Guide lines for Continuous Internal Evaluation (CIE)**

a. For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (ii) one descriptive examination (iii) one assignment and (iv) one Subject Seminar. The online examination (objective) shall be 10 marks with duration of 20 minutes, descriptive examination shall be for 10 marks with a duration of 1 hour 30 minutes, assignment test shall be 5 marks with duration of 50 minutes (Open book system with questions of L4 standard on Bloom's scale) and 90 minutes for descriptive paper) and Subject Seminar 5 marks.

b. The first online examination (objective) is set with 20 multiple choice questions for 10 marks (20 questions x 1/2 marks) from first two and half units (50% of the syllabus).

c. The descriptive examination is set with 3 full questions for 10 marks each from first two and half units (50% of the syllabus), the student has to answer all questions.

d. The Assignment Test from first two and half units conducted for 20 Marks and will be scaled down to 5 Marks. The test is open book system and the duration of the exam is 50 minutes. Students can bring a maximum of three printed text books related to that subject. (Soft copies of the text books will not be allowed.) The assignments have to provide broadened exposure to the course. The questions shall include problem solving approach, problem analysis & design, implementation, case studies etc.

e. For the subject seminar 5 marks, each student shall be evaluated based on the presentation on any topic of his/her choice in the subject duly approved by the faculty member concerned.

f. For the subject having design and / or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests).

In the similar lines, the mid-2 examinations shall be conducted on the rest of the syllabus.

f. For practical subjects there shall be continuous evaluation during the semester for 25 marks. The internal 25 marks shall be awarded as follows: day to day work 5 marks, record 5 marks and the remaining 15 marks are to be awarded by conducting an internal laboratory test of 3 hours duration.

g. The mid marks submitted to the examination section shall be displayed in the concerned department notice boards for the benefit of the students. If any discrepancy found in the displayed Mid marks, it shall be brought to the notice of examination section within two working days from the date of display.

h. Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for another mid exam.

Example:

Mid-1 marks = Marks secured in (online examination-1+descriptive examination-1 +one assignment-1 + Seminar-1)

Mid-2 marks = Marks secured in (online examination-2+descriptive examination-2 +one assignment-2 + Seminar-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

v. **Semester End Examinations Evaluation:**

a. The semester end examinations for theory subjects will be conducted autonomous examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b. For practical subjects shall be conducted for 35 marks by the teacher concerned and external examiner appointed by Chief superintendent/ Controller of Examinations (CoE), VVIT. All the laboratory records and internal test papers shall be preserved in respective departments as per autonomous norms and shall be produced to the Committees as and when they ask for.

c. Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this internship during summer vacation just before its offering as per course structure. The minimum duration of this course shall be at least 6 weeks. The student shall register for the internship as per course structure after commencement of academic year. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the academic regulations. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner appointed by Chief superintendent/ CoE; Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the examination section.

d. The job-oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief superintendent/ CoE) and internal examiner (course instructor or mentor). There are no internal marks for the job-oriented skill courses.

e. Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc. non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the department internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

f. Procedure for Conduct and Evaluation of MOOC: There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL/etc., through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

g. Major Project (Project - Project work, seminar, and internship in industry): In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner. Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the Chief superintendent/ CoE and is evaluated for 140 marks.

vi. Recounting/ Revaluation/ Revaluation by Challenge in the End Semester Examination: A student can request for recounting/ revaluation/ revaluation by challenge of his/her answer book on payment of a prescribed fee as per autonomous norms.

vii. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the examination section.

viii. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the academic council.

ix. If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

10. Promotion Rules:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.8 for promotion to higher classes

i. A student shall be promoted from first year to second year if he fulfils the minimum attendance requirements.

ii. A student will be promoted from II year to III year if he fulfils the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

iii. A student shall be promoted from III year to IV year if he fulfils the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

11. Course Pattern

i. The entire course of study is for four academic years; all years are on semester pattern.

ii. A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.

iii. When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

12. Grading:

The grade points and letter grade will be awarded to each course based on students' performance as per the grading system shown in the following Table.

% of Marks	Letter Grade	Level	Grade Points
≥ 90	**A+**	Outstanding	10
≥ 80 to < 89	**A**	Excellent	9
≥ 70 to < 79	**B**	Very Good	8
≥ 60 to < 69	**C**	Good	7
≥ 50 to < 59	**D**	Fair	6
≥ 40 to < 49	**E**	Satisfactory	5
< 40	**F**	Fail	0
ABSENT	**Ab**	Absent	0

13. Computation of SGPA and CGPA

i. The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA(S_i) = Σ (C_i × G_i)/ Σ C_i

where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course

ii. The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

CGPA = Σ (C_i × Si)/ Σ Ci

where 'S_i' is the SGPA of the ith semester and C_i is the total number of credits in that semester

iii. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. While computing the SGPA/CGPA, the subjects in which the student is awarded Zero grade points will also be included.

v. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

vi. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters A+, A, B, C, D, E and F.

vii. As per AICTE regulations, conversion of CGPA into equivalent percentage as follows:

Equivalent Percentage = (CGPA – 0.75) x 10

viii. Illustration of Computation of SGPA and CGPA

Illustration for SGPA: Let us assume there are 6 subjects in a semester. The grades obtained as follows:

Course	Credit	Grade Obtained	Grade point	Credit x Grade Point
Subject 1	3	B	8	3 X 8 = 24
Subject 2	4	C	7	4 X 7 = 28
Subject 3	3	D	6	3 X 6 = 18
Subject 4	3	A+	10	3 X 10 = 30
Subject 5	3	E	5	3 X 5 = 15
Subject 6	4	D	6	4 X 6 = 24
	20			139

Thus, SGPA (S_i) =139/20 =6.95=6.9 (approx.)

Illustration for CGPA:

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6	Sem-7	Sem-8
Credits	20	22	25	26	26	25	21	23
SGPA	6.9	7.8	5.6	6.0	6.3	8.0	6.4	7.5

$$CGPA = \frac{20\,X6.9 + 22X7.8 + 25X5.6 + 26X6.0 + 26X6.3 + 25X8.0 + 21X6.4 + 23X7.5}{188}$$

$$= \frac{1276.3}{188} = 6.78$$

14. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. degree, he/she shall be placed in one of the following:

Class Awarded	CGPA to be secured
First Class with distinction*	≥ 7.75 (Without any supplementary appearance)
First Class	≥ 6.75
Second Class	≥ 5.75 to < 6.75
Pass Class	≥ 5.00 to < 5.75
Fail	< 5.00

* Awarded only if all the credit courses prescribed are cleared within four years for regular candidates and three years for lateral entry candidates

The students who are approved for break in study for entrepreneurships / start-up's will also be considered for award of first class with distinction

For the purpose of awarding First, Second and Pass Class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the program shall been considered

15. Gap - Year:

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

16. Transitory Regulations

A candidate, who is detained or discontinued a semester, on re-admission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which the student joins subsequently and the academic regulations be applicable to him/her which are in force at the time of his/her admission. However, exemption will be given to those candidates who have already passed in such courses in the earlier semester(s) and additional courses are to be studied as approved by Board of Studies and ratified by Academic Council.

17. Curricular Framework for Honors Programme

i. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

ii. A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA up to the end of 2^{nd} semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4^{th} semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.

iii. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.

iv. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

v. Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12 weeks as recommended by the Board of studies.

vi. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.

vii. The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

viii. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component.

ix. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.

x. The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

xi. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

xii. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiii. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

18. Curricular Framework for Minor Programme

i. Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

ii. Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

iii. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.

iv. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.

v. There shall be no limit on the number of programs offered under Minor. The college can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

vi. The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

vii. A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA up to 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

viii. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

ix. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

x. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the University/academic council.

xi. Student can opt for the industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

xii. A committee should be formed at the level of college / department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

xiii. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript or None of the courses done under the dropped Minor will be shown in the transcript.

xiv. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xv. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor’s degree.

19. Industrial Collaborations (Case Study)

Institution-Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Universities in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry, and society at large.

The Institutions are permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Institutions can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Institutions shall also explore the possibilities of collaborations with major industries in the core sectors and professional bodies to create specialized domain skills.

20. Amendments to Regulations: The college may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Board of Studies with the approval of Academic Council and Governing Body of the college.

21. Transferred Students: The students seeking transfer to VVIT from various Universities/ Institutions have to obtain the credits of any equivalent subjects as prescribed by the Academic Council. Only the internal marks obtained in the previous institution will be considered for evaluation of failed subjects.

1. **Award of B. Tech. Degree**: A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:
   i. A student shall be declared eligible for award of the B. Tech Degree, if he pursues a course of study in not less than four and not more than eight academic years. After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.
   ii. The student shall register for 160 credits and must secure all the 160 credits.

   Award of B. Tech. (Honor)/B. Tech. (Minor): A student shall be eligible for the award of B. Tech degree with Honors or Minor if the student earns 20 additional credits are acquired as per the regulations/guidelines. The regulations/guidelines are separately provided. Registering for an Honors/Minor is optional.

2. **Courses of Study:** The following courses of study are offered at present as specializations for theB. Tech. Courses

S. No.	Branch	Branch Short Form	Branch Code
1	Civil Engineering	CIV	01
2	Electrical and Electronics Engineering	EEE	02
3	Mechanical Engineering	MEC	03
4	Electronics and Communication Engineering	ECE	04
5	Computer Science and Engineering	CSE	05
6	Information Technology	INF	12
7	CSE (Artificial Intelligence and Machine Learning)	CSM	42
8	CSE (Internet of Things and Cyber Security with Block Chain Technology)	CIC	47
9	CSE (Internet of Things)	CSO	49
10	Artificial Intelligence and Data Science	AID	54
11	Artificial Intelligence and Machine Learning	AIM	61

3. **Medium of Instruction:** The medium of instruction of the entire B. Tech undergraduate programme in Engineering & Technology (including examinations and project reports) will be in English only.

4. **Admissions:** Admission to the B. Tech Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or on the basis of any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

5. **Structure of the Undergraduate Engineering program:** Every course of B. Tech. Program shall be placed in one of the nine categories as listed in table below:

S.No.	Category	Breakup of Credits
1	Humanities and Social Science including Management courses	10.5 - 12
2	Basic Science Courses	21 - 25
3	Engineering Science Courses	24
4	Professional core Courses	48 - 51
5	Open Elective Courses	12 - 18
6	Professional Elective Courses	15 - 18
7	Internship, Seminar, Project Wok	15 – 16.5
8	Mandatory Courses	NC
9	Skill Oriented Courses	----
	Total Credits	160

** Breakup of Credits based on AICTE /APSCHE

Assigning of Credits

- Hr. Lecture (L) per week - 1 credit
- Hr. Tutorial (T) per week - 1 credit
- Hr. Practical (P) per week - 0.5 credits

6. **Programme Pattern**:

a) Total duration of the of B. Tech (Regular) Programme is four academic years

b) Each Academic year of study is divided into Two Semesters.

c) Minimum number of instruction days in each semester is 90.

d) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).

e) The total credits for the Programme is 160.0

f) Athree-week induction program is mandatory for all first year UG students and shall be conducted as per AICTE/UGC/APSCHE guidelines.

g) Student is introduced to “Choice Based Credit System (CBCS)”.

h) A pool of interdisciplinary and job-oriented mandatory skill courses which are relevant to the industry are integrated into the curriculum of concerned branch of engineering (total five skill courses: two basic level skill courses, one on soft skills and other two on advanced level skill courses)

i) A student has to register for all courses in a semester.

j) All the registered credits will be considered for the calculation of final CGPA.

k) Each semester has - ‘Continuous Internal Evaluation (CIE)’ and ‘Semester End Examination (SEE)’. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and course structure as suggested by AICTE are followed.

l) A 10 months industry/field mandatory internship, both industry and social, during the summer vacation and also in the final semester to acquire the skills required for job and make engineering graduates to connect with the needs of the industry and society at large.

m) All the students shall be mandatorily registered for NCC, NSS activities and Community Service Project as per the Government and University norms.

n) Courses like Environmental Science, Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses.

Environmental Science is to be offered compulsorily as mandatory course for all branches.

n) Each college shall assign a faculty advisor/mentor after admission to each student or group of students from same department to provide guidance in courses registration/career growth/ placements/opportunities for higher studies/GATE/other competitive exams etc.

8. Registration for Courses

i. The college shall invite registration forms from the students at the beginning of the semester for the registration for courses each semester. The registration process shall be closed within one week. If any student wishes to withdraw the registration, he/she shall submit a letter to the principal through the class teacher/instructor and HOD. The principal shall communicate the registration and withdraw details courses of each student in a consolidated form to the college examination section and University without fail.

ii. There are four open electives in each branch. All Open Electives are offered to students of all branches in general. A student shall choose an open elective, by consulting the HOD/advisor, from the list in such a manner that he/she has not studied the same course in any form during the Programme. The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

iii. A student shall be permitted to pursue up to a maximum of two elective courses under MOOCs during the programme. Enrollment of MOOC course will be initiated from the date of commencement of class work for Second Year – 2nd Semester. Students are advised to register for only for minimum 12 weeks in duration MOOCs courses. Student has to pursue and acquire a certificate for a MOOC course only from the SWAY/NPTE through online with the approved by the BoS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester. The details of the MOOCs courses registered by the students shall be submitted to the University examination center as well as college examination center. The Head of the Department shall appoint a mentor for each of the MOOC subjects registered by the students to monitor the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. MOOC course completion certificate must be submitted on or before the completion of Fourth Year – 1st Semester to consider it for Regular evaluation. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

iv. Two summer internships each with a minimum of six weeks duration shall be mandatorily done/completed respectively at the end of second and third years (during summer vacations). The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs. After completing the summer internship, the students shall register in the immediate respective odd semester and it will be evaluated at the end of the semester as per norms of the autonomy. The student has to produce the summer internship satisfactory report and certificate taken from the organization to be considered for evaluation. The College shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

v. In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

vi. Curricular Framework for Skill oriented courses

a. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.

b. For skill oriented/skill advanced course, one theory and 2 practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.

c. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining two shall be skill-advanced courses either from the same domain or job-oriented skill courses, which can be of inter disciplinary nature.

d. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HoD of the college.

e. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies. However, the department has to assign mentors in the college to monitor the performance of the students.

f. If a student chooses to take a certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the department, then the department shall mark overall attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency. The credits will be awarded to the student upon producing the successful course completion certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per BoS norms at the end of the semester.

9. Attendance Requirements:

i. A student is eligible to write the University examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

ii. Shortage of Attendance below 65% in aggregate shall in NO case be condoned. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that class and their registration shall stand cancelled.

iii. Condonation for shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

iv. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

v. A student will be promoted to the next semester if he satisfies the (a) attendance requirement of the present semester and (b) minimum required credits (from Vth Semester onwards).

vi. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

vii. For induction programme attendance shall be maintained as per AICTE norms.

viii. For non-credit mandatory courses the students shall maintain the attendance similar to credit courses.

10. Evaluation-Distribution and Weightage of marks

Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Academic Council of the institute from time to time.

i. A student is deemed to have satisfied the minimum academic requirements if he/she has earned the credits allotted to each theory/practical design/drawing subject/ project etc. by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

ii. For non-credit mandatory courses, like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

iii. **Distribution and Weightage of marks:** The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The performance of a student in each semester shall be evaluated subject–wise with a maximum of 100 marks for theory subject, 50 marks for practical subject/Mini Project/Internship/Industrial Training/ Skill

Development programmes/Research Project, and 200 marks for end Project Work.

iv. Guide lines for Continuous Internal Evaluation (CIE)

a. For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (ii) one descriptive examination (iii) one assignment and (iv) one Subject Seminar. The online examination (objective) shall be 10 marks with duration of 20 minutes, descriptive examination shall be for 10 marks with a duration of 1 hour 30 minutes, assignment test shall be 5 marks with duration of 50 minutes (Open book system with questions of L4 standard on Bloom's scale) for objective and Subject Seminar 5 marks.

b. The first online examination (objective) is set with 20 multiple choice questions for 10 marks (20 questions x 1/2 marks) from first two and half units (50% of the syllabus).

c. The descriptive examination is set with 3 full questions for 10 marks each from first two and half units (50% of the syllabus), the student has to answer all questions.

d. The Assignment Test from first two and half units conducted for 20 Marks and will be scaled down to 5 Marks. The test is open book system and the duration of the exam is 50 minutes. Students can bring a maximum of three printed text books related to that subject. (Soft copies of the text books will not be allowed.) The assignments have to provide broadened exposure to the course. The questions shall include problem solving approach, problem analysis & design, implementation, case studies etc.

e. For the subject seminar 5 marks, each student shall be evaluated based on the presentation on any topic of his/her choice in the subject duly approved by the faculty member concerned.

f. For the subject having design and / or drawing (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests).

In the similar lines, the mid-2 examinations shall be conducted on the rest of the syllabus.

g. For practical subjects there shall be continuous evaluation during the semester for 25 marks. The internal 25 marks shall be awarded as follows: day to day work 5 marks, Record 5 marks and the remaining 15 marks are to be awarded by conducting an internal laboratory test of 3 hours duration.

h. The mid marks submitted to the examination section shall be displayed in the concerned department notice boards for the benefit of the students. If any discrepancy found in the displayed Mid marks, it shall be brought to the notice of examination section within two working days from the date of display.

i. Internal marks can be calculated with 80% weightage for better of the two Mids and 20% Weightage for another mid exam.

Example:

Mid-1 marks = Marks secured in (online examination-1+descriptive examination-1 +one assignment-1 + Seminar-1)

Mid-2 marks = Marks secured in (online examination-2+descriptive examination-2 +one assignment-2 + Seminar-2)

Final Internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

v. Semester End Examinations Evaluation:

a. The semester end examinations for theory subjects will be conducted autonomous examination section for 70 marks consists of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b. For practical subjects shall be conducted for 35 marks by the teacher concerned and external examiner appointed by Chief superintendent/ Controller of Examinations(CoE), VVIT. All the laboratory records and internal test papers shall be preserved in respective departments as per autonomous norms and shall be produced to the Committees as and when they ask for.

c. Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this internship during summer vacation just before its offering as per course structure. The minimum duration of this course shall be at least 6 weeks. The student shall register for the internship as per course structure after commencement of academic year. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the academic regulations. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner appointed by Chief superintendent/ CoE; Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the examination section.

d. The job-oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief superintendent/ CoE) and internal examiner (course instructor or mentor). There are no internal marks for the job-oriented skill courses.

e. Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the department internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

f. Procedure for Conduct and Evaluation of MOOC: There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL/etc., through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall be passed.

g. Major Project (Project - Project work, seminar and internship in industry): In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner. Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the Chief superintendent/ CoE and is evaluated for 140 marks.

vi. Recounting/ Revaluation/ Revaluation by Challenge in the End Semester Examination: A student can request for recounting/ revaluation/ revaluation by challenge of his/her answer book on payment of a prescribed fee as per autonomous norms.

vii. Supplementary Examinations: A student who has failed to secure the required credits can appear for a supplementary examination, as per the schedule announced by the examination section.

viii. Malpractices in Examinations: Disciplinary action shall be taken in case of malpractices during Mid/End examinations as per the rules framed by the academic council.

ix. If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

11. Promotion Rules:

i. A student shall be promoted from first year to second year if he fulfills the minimum attendance requirements.

ii. A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

iii. A student shall be promoted from III year to IV year if he fulfills the academicrequirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

12. Course Pattern

i. The entire course of study is for four academic years; all years are on semester pattern.

ii. A student eligible to appear for the end semester examination in a subject, but absent from it or has failed in the end semester examination, may write the exam in that subject when conducted next.

iii. When a student is detained for lack of credits/shortage of attendance, he may be re-admitted into the same semester/year in which he has been detained. However, the academic regulations under which he was first admitted shall continue to be applicable to him.

13.Grading:

The grade points and letter grade will be awarded to each course based on students' performance as per the grading system shown in the following Table.

% of Marks	Letter Grade	Level	Grade Points
≥ 90	**A+**	Outstanding	10
80 to 89	**A**	Excellent	9
70 to 79	**B**	Very Good	8
60 to 69	**C**	Good	7
50 to 59	**D**	Fair	6
40 to 49	**E**	Satisfactory	5
<40	**F**	Fail	0
ABSENT	**AB**	Absent	0

14. Computation of SGPA and CGPA

i. The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

   $SGPA(S_i) = \Sigma (C_i \times G_i) / \Sigma C_i$

   where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course

ii. The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

   $CGPA = \Sigma (C_i \times S_i) / \Sigma C_i$

   where 'S_i' is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester

iii. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. While computing the SGPA/CGPA, the subjects in which the student is awarded Zero grade points will also be included.

v. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

vi. Letter Grade: It is an index of the performance of students in a said course. Grades are denotedby letters A+, A, B, C, D, E and F.

vii. As per AICTE Norms, conversion of CGPA into equivalent percentage as follows:

Equivalent Percentage = (CGPA – 0.50) x 10

viii. Illustration of Computation of SGPA and CGPA

Illustration for SGPA: Let us assume there are 6 subjects in a semester. The grades obtained as follows:

Course	Credit	Grade Obtained	Grade point	Credit x Grade Point
Subject 1	3	B	8	3 X 8 = 24
Subject 2	4	C	7	4 X 7 = 28
Subject 3	3	D	6	3 X 6 = 18
Subject 4	3	A^+	10	3 X 10 = 30
Subject 5	3	E	5	3 X 5 = 15
Subject 6	4	D	6	4 X 6 = 24
	20			139

Thus, SGPA (S_i) =139/20 =6.95=6.9 (approx.)

Illustration for CGPA:

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6	Sem-7	Sem-8
Credits	20	22	25	26	26	25	21	23
SGPA	6.9	7.8	5.6	6.0	6.3	8.0	6.4	7.5

$$\boldsymbol{CGPA = \frac{20\,X6.9 + 22X7.8 + 25X5.6 + 26X6.0 + 26X6.3 + 25X8.0 + 21X6.4 + 23X7.5}{188}}$$

$$\boldsymbol{= \frac{1276.3}{188} = 6.78}$$

15. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. degree, he/she shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured
First Class with distinction*	≥7.75
First Class	≥6.75 &<7.75
Second Class	≥5.75 &<6.75
Pass Class	≥5&<5.75
Fail	<5

* Awarded only if all the credit courses prescribed are cleared within four years for regular candidates and three years for lateral entry candidates

Thestudents who are approved for break in study for entrepreneurships/startups will also be considered for award of first class with distinction

For the purpose of awarding First, Second and Pass Class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the program shall been considered

16.Gap - Year:

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at university level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

17. Transitory Regulations

A candidate, who is detained or discontinued a semester, on re-admission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which the student joins subsequently and the academic regulations be applicable to him/her which are in force at the time of his/her admission. However, exemption will be given to those candidates who have already passed in such courses in the earlier semester(s) and additional courses are to be studied as approved by Board of Studies and ratified by Academic Council.

18. Curricular Framework forHonors Programme

i. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

ii. A student shall be permitted to register for Honors program at the beginning of 4thsemester provided that the student must have acquired a minimum of 8.0 SGPA up to the end of 2ndsemester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4thsemester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.

iii. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completesthe selected advanced courses from samebranch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.

iv. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

v. Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.

vi. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.

vii. The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

viii. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component.

ix. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.

x. The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

xi. If a student drops or is terminated from the Honorsprogram, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

xii. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xiii. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor’s degree.

19. Curricular Framework for Minor Programme

i. Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

ii. Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

iii. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE,ME etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science(DS), Robotics, Electric vehicles, Robotics, VLSI etc.

iv. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.

v. There shall be no limit on the number of programs offered under Minor. The college can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

vi. The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

vii. A student shall be permitted to register for Minors program at the beginning of 4thsemester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) up to the end of 2ndsemester without any history of backlogs. It is expected that the 3rd semesterresults may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA up to 3rdsemester or failed in any of the courses, his registration forMinors program shall stand cancelled. An SGPA of 8 has to be maintained in thesubsequent semesters without any backlog in order to keep the Minors registration active.

viii. A student shall earn additional 20 credits in the specified area to be eligible fortheaward of B. Tech degree with Minor. This is in addition to the credits essential forobtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).

ix. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

x. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the University/academic council.

xi. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

xii. A committee should be formed at the level of College/department toevaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

xiii. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a“pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript orNone of the courses done under the dropped Minor will be shown in the transcript.

xiv. In case a student fails to meet the CGPA requirement for B.Techdegree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degreewith Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

xv. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor’s degree.

20. Industrial Collaborations (Case Study)

Institution-Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Universities in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

The Institutions are permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Institutions can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Institutions shall also explore the possibilities of collaborations with major industries in the core sectors and professional bodies to create specialized domain skills.

21. Amendments to Regulations: The college may from time-to-time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Board of Studies with the approval of Academic Council and Governing Body of the college.

22. Transferred Students: The students seeking transfer to VVIT from various Universities/ Institutions have to obtain the credits of any equivalent subjects as prescribed by the Academic Council. Only the internal marks obtained in the previous institution will be considered for evaluation of failed subjects.

ACADEMIC REGULATIONS (R20) FOR B. TECH.

(LATERAL ENTRY SCHEME)

Applicable for the students admitted into II year B. Tech. from the Academic Year 2021-22onwards

1. **Award of B. Tech. Degree:** A student will be declared eligible for the award of B. Tech. Degree if he fulfills the following academic regulations:
   - A student shall be declared eligible for the award of the B. Tech Degree, if he pursues a course of study in not less than three academic years and not more than six academic years.
   - The candidate shall register for 121 credits and secure all the 121 credits.
   - A student shall be eligible for the award of B.Tech degree with Honors or Minor if he/she earns 20 credits in addition to the 121 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

2. The attendance regulations of B. Tech. (Regular) shall be applicable to B.Tech Lateral Entry Students.

3. **Promotion Rule**
   - A student shall be promoted from second year to third year if he fulfills the minimum attendance requirement.
   - A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

4. **Award of Class**

After a student has satisfied the requirement prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured
First Class with distinction*	≥ 7.75 (Without any supplementary appearance)
First Class	≥ 6.75
Second Class	≥ 5.75 to < 6.75
Pass Class	≥ 5.00 to < 5.75

Fail	< 5.00

5. All the other regulations as applicable to B. Tech. 4-year degree course(Regular) will hold good for B. Tech Lateral Entry Scheme.

MALPRACTICE RULES

DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

S.No.	Nature of Malpractices/Improper conduct	Punishment
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to

	appearing.	appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be

		permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular	Student of the college expulsion from the examination hall and

	examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

In case any emergency call Toll Free No. 1800 425 1288

LET US MAKE VVIT A RAGGING FREE CAMPUS

ABSOLUTELY
NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

In case any emergency call Toll Free No. 1800 425 1288
LET US MAKE VVIT A RAGGING FREE CAMPUS

COURSE STRUCTURE

I Year I Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20SH1T01	Mathematics-I	2	1	0	3
2	20SH1T05	Applied Chemistry	3	0	0	3
3	20EE1T01	Basic Electrical and Electronics Engineering	2	1	0	3
4	20CS1L02	Computer Engineering Workshop	1	0	4	3
5	20CS1T01	Problem Solving using C	2	1	0	3
6	20SH1L04	Applied Chemistry Lab	0	0	3	1.5
7	20EE1L01	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5
8	20CS1L01	Problem Solving using C Lab	0	0	3	1.5
9		Life Skills-I	2	0	0	0
Total Credits						**19.5**

I Year II Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20SH2T01	Mathematics-II	2	1	0	3
2	20SH2T03	Applied Physics	2	1	0	3
3	20SH2T02	Communicative English	3	0	0	3
4	20CS2T01	Problem solving using Python	3	0	0	3
5	20EC2T03	Digital Logic Design	2	1	0	3
6	20SH2L03	Applied Physics Lab and Virtual Lab	0	0	3	1.5
7	20SH2L03	Communicative English Lab	0	0	3	1.5
8	20CS2L01	Problem solving using Python Lab	0	0	3	1.5
9	20SH2N02	Environmental Science	2	0	0	0
10		Life Skills-II	2	0	0	0
Total Credits						**19.5**

II Year I Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20SH3T01	Mathematics – III	2	1	0	3
2	20CO3T01	Mathematical Foundations of Computer Science	2	1	0	3

3	20CO3T02	Data Structures	3	0	0	3
4	20CO3T03	Java Programming	3	0	0	3
5	20CO3T04	Data Communications and Networking for IoT	3	0	0	3
6	20CO3L02	Data Structures Lab	0	0	3	1.5
7	20CO3O03	Java Programming Lab	0	0	3	1.5
8	20CO3L04	Data Communications and Networking for IoT Lab	0	0	3	1.5
9	20CO3C01	Introduction to Electronics Hardware and Software	0	0	4	2
10	20SH3N01	Essence of Indian Traditional Knowledge	2	0	0	0
11		Life Skills-III	2	0	0	0
		Total Credits				**21.5**

II Year II Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20SH4T01	Probability and Statistics	2	1	0	3
2	20EC4T04	Computer Organization	3	0	0	3
3	20CO4T01	Operating Systems	3	0	0	3
4	20CO4T02	Database Management Systems	3	0	0	3
5	20CO4T03	Introduction to IoT	3	0	0	3
6	20EC4L03	Computer Organization and IoT Lab	0	0	3	1.5
7	20CO4L02	Operating Systems Lab	0	0	3	1.5
8	20CO4L01	Database Management Systems Lab	0	0	3	1.5
9	20CO4C01	Sensors and Actuators for IoT	0	0	4	2
10		Life Skills-IV	2	0	0	0
		Total Credits				**21.5**
		Internship / Community Service Project 2 Months (Mandatory) during summer vacation				
		Honors/Minor courses	3	0	2	4

III Year I Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20CO5T01	Protocols and Architectures for Wireless Sensor Networks	3	0	0	3
2	20CO5T02	Machine Learning	3	0	0	3
3	20CO5T03	Automata Theory and Compiler Design	3	0	0	3
4	20CO5P05	Professional Elective-1 1. Advanced Computer Architecture 2. Social Networks 3. Software Engineering 4. Computer Graphics 5. Design and Analysis of Algorithms	3	0	0	3
5	20EC5O02	Open Elective-1 1. Microprocessors and Microcontrollers for IoT 2. Data Warehousing and Data Mining 3. Optimization Techniques 4. Green Buildings	3	0	0	3
6	20CO5L01	Protocols and Architectures for Wireless Sensor Networks Lab	0	0	3	1.5
7	20CO5L02	Machine Learning Lab	0	0	3	1.5
8	20CO5E01	.NET Eco Systems	0	0	4	2
9	20SH5N02	Constitution of India	2	0	0	0
10	20CO5R01	Summer Internship / Community Service Project 2 Months (Mandatory) after second year (to be evaluated during V semester)	0	0	0	1.5
11		Life Skills-V	2	0	0	0
		Total Credits				**21.5**
		Honors/Minor courses	3	0	2	4

III Year II Semester

S. No	Course code	Course Name	L	T	P	Credits
1	20SH6T02	Engineering Economics and Management	3	0	0	3
2	20CO6T01	Embedded Real Time Operating Systems	3	0	0	3
3	20CO6T02	Mobile Application Development for IoT	3	0	0	3
4	20CO6P01	Professional Elective-2 1. Advanced Java Programming 2. E-Commerce 3. Principles of Programming Languages 4. Agile Software Development 5. (NPTEL/SWAYAM)	3	0	0	3
5	20IT6O02	Open Elective-2 1. E-Waste Management 2. Software Project Management 3. Semantic Web and Social Networks 4. Environment Pollution and Control	3	0	0	3
6	20CO6L01	Embedded Real Time Operating Systems Lab	0	0	3	1.5
7	20CO6L02	Mobile Application Development for IoT Lab	0	0	3	1.5
8	20CO6L03	Front End Application Development Lab	0	0	3	1.5
9	20CO6E01	Soft skills	0	0	4	2
10	20SH6N01	Entrepreneurial Skill Development	2	0	0	0
11		Life Skills-VI	2	0	0	0
		Total Credits				**21.5**
		Industrial/Research Internship 2 Months (Mandatory) during summer vacation				
		Honors/Minor courses	3	0	2	4

IV Year I Semester

S. No	Course code	Course Name	L	T	P	Credits
1	HSE4101	Humanities and Social Science Elective 1. Universal Human Values-2: Understanding Harmony 2. Human Resources Development 3. Business Intelligence 4. Management and Organizational Behaviour 5. Strategic Management	3	0	0	3
2	PE4101	Professional Elective-3 1. Industrial and Medical IoT 2. Programming and Interfacing with Microcontrollers 3. Deep Learning 4. Mobile Computing 5. Privacy and Security in IoT	3	0	0	3
3	PE4102	Professional Elective-4 1. Applications of IoT in Robotics 2. No SQL Databases 3. Mean Stack Technologies 4. Wearable Computing 5. Big Data Analytics	3	0	0	3
4	PE4103	Professional Elective-5 1. Cognitive IoT 2. Data Science, Preparation and Analysis 3. DevOps 4. Human Computer Interaction 5. (NPTEL/SWAYAM)	3	0	0	3
5	OE4101	Open Elective-3 1. Cyber Forensics 2. Disaster Management 3. Logistics and Supply Chain Management 4. Cyber Security Essentials	3	0	0	3
6	OE4102	Open Elective-4 1. Cryptography and Network Security 2. Blockchain Technologies 3. High Performance Computing 4. Edge Computing	3	0	0	3

7	SAC4101	Power BI / Competitive coding	0	0	4	2
8	PR	Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)	0	0	0	3
9		Life Skills-VII	2	0	0	0
		Total Credits				**23**
		Honors/Minor courses	3	0	2	4

IV Year II Semester

S. No	Course code	Course Name	L	T	P	Credits
1	PROJ4201	Major Project (Project work, seminar, and internship in industry)	0	0	0	8
		Internship (6 months)				
		Total Credits				**12**

* CSP (Community Service Project) is evaluated in the Final Year and 4 credits will be awarded by splitting the credits from if IV Year – II Semester Major Project as per the Proceedings No. JNTUK/DAP/CSP/Distribution of Credits/2022 dated on 24-09-2022.

Courses for Honors degree

POOL-1	POOL-2	POOL-3	POOL-4
Advanced Python Programming	Software Testing Methodologies	Advanced Data Structures	Natural Language Processing
Advanced Operating Systems	Cyber Law & Ethics	Advanced Database Systems	Sentiment Analysis
RFID and Micro Controllers	Energy harvesting technologies and power management for IoT Devices	Database Security and Privacy	Computer Vision
Robotics and Automation in Food Industry	Design and Testing of Digital Systems	Kernel and Driver Programming	SDN and NFV for IOT
Biomedical Sensors	Ethical Hacking	Storage Area Networks	FOG Computing
MOOC-1* (NPTEL/SWAYAM) Duration: 12 Weeks minimum			
MOOC-2* (NPTEL/SWAYAM) Duration: 12 Weeks minimum			

*Course/subject title cannot be repeated

Note:

1. **A student has to acquire 16 credits with minimum one subject from each pool.**
2. **Compulsory MOOC/NPTEL course for 4 credits (2 course, each 2 credited)**

General Minor degree courses offered by CSO department

1. Introduction to IoT
2. Protocols and Architectures for Wireless Sensor Networks
3. Mobile Application Development for IoT
4. Privacy and Security in IoT
5. Industrial and Medical IoT
6. Applications of IoT in Robotics
7. Biomedical Sensors
8. Sensors and Actuators for IoT

Note:

i. A Student can select four subjects from the above eight subjects @ 3-0-2-4 credits per subject.

ii. Compulsory MOOC/NPTEL courses for 04 credits (02 courses @ 02 credits each)

(***)

VVIT Life skill courses

The following courses are admitted to be the **courses beyond curriculum** to improve individual life skills. These courses will be demonstrated in the class room and will be having an internal assessment for satisfactory.

S. No	Year and Semester	Course Name
1	I Year I Semester (Semester-1)	Quantitative Aptitude
2	I Year II Semester (Semester-2)	Verbal Ability
3	II Year I Semester (Semester-3)	Understanding Self for Effectiveness
4	II Year II Semester (Semester-4)	Design Thinking
5	III Year I Semester (Semester-5)	Stress and Coping Strategies
6	III Year II Semester (Semester-6)	Research Skills

I-Year-I Semester	Mathematics-I	L	T	P	C
20SH1T01		2	1	0	3

Course objectives:
The main objectives are
1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

Unit–1: (10 hrs)
Differential equations of first order and first degree
Linear differential equations-Bernoulli's equations - Exact equations and equations reducible to exact form.
Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.
Unit–2: (9 hrs)
Linear differential equations of higher order
Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, $\sin ax$, $\cos ax$, polynomials in x^n , $e^{ax}V(x)$ and $x^n V(x)$ - Method of Variation of Parameters.
Applications: LCR circuit – Simple harmonic motion
Unit–3: (9 hrs)
Mean value theorems
Mean value theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.
Unit–4: (10 hrs)
Partial differentiation
Introduction – Homogeneous function – Euler's theorem - Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).
Unit–5: (10 hrs)
Multiple integrals
Double integrals (Cartesian and Polar) – Change of order of integration – Change of variables (Cartesian to Polar) –Triple integrals.

Applications: Areas by double integrals and Volumes by triple integrals.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 solve the differential equations related to various engineering fields.

CO2 utilize mean value theorems to real life problems.

CO3 familiarize with functions of several variables which is useful in optimization.

CO4 apply double integration techniques in evaluating areas bounded by region.

CO5 learn important tools of calculus in higher dimensions. Students will become familiar with 2-dimensional and 3 – dimensional coordinate systems.

Text books:

1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference books:

1. **H. K. Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
2. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

I-Year-I Semester	Applied Chemistry	L	T	P	C
20SH1T05		3	0	0	3

Course objectives:
The main objectives are

1. Significance of various types of plastic materials in household appliances and composites (FRP) in aerospace and automotive industries.
2. Understand the basic concepts of electrochemistry, which are useful to construct the electrochemical cells, batteries and fuel cells.
3. Illustrate the theories and mechanism of corrosion and its prevention.
4. Importance of advanced materials and their engineering applications.
5. Make use of molecular machines in supramolecular chemistry and need of green chemistry.
6. Design and construction of advanced instrumental techniques and recall their importance.

Unit – 1: Polymer Technology (11 hrs)
Polymerisation: Introduction-Methods of polymerisation-(emulsion and suspension)-Physical and mechanical properties.
Plastics: Compounding-Fabrication (compression, injection, blown film, extrusion)-Preparation, properties and applications of PVC, ploycarbonates and Bakelite-Mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.
Elastomers: Natural rubber-Drawbacks-Vulcanization-Preparation-Properties and applications of synthetic rubbers (Buna S, thiokol and polyurethanes)
Composite Materials: Fiber reinforced plastics-CFRP and GFRP
Conducting polymers: Polyacetylene, doped conducting polymers -p-type and n-type doping.
Bio degradable polymers: Biopolymers and biomedical polymers.
Unit-2: Electrochemical Cells and Corrosion (9 hrs)
Single electrode potential-Electrochemical series and uses of series-Standard hydrogen electrode, calomel electrode, concentration cell, construction of glass electrode, Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li-ion battery, Zinc air cells, Fuel cells-H_2 –O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.
Corrosion: Definition-theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, water-line corrosion- passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control: (proper designing, cathodic protection)-protective coatings: cathodic and anodic coatings, electroplating, electroless plating (nickel), paints (constituents and its functions).

Unit-3: **Material Chemistry (9 hrs)**

Non-elemental semiconducting materails: Stoichiometric, controlled valency & chalcogen photo/semiconductors-preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling technique) – Semiconductor devices (p-n junction diode as rectifier, junction transistor)

Nano materials: Introduction, sol-gel method, characterization by BET, SEM and TEM methods, applications of graphene-carbon nanotubes and fullerenes: Types, preparation of carbon nanomaterials by carbon-arc, laser abalation methods.

Liquid crystals: Introduction-types-applications.

Superconductors: Meissner effect, type- I and type- II superconductors, characteristics and applications.

Unit-4: Advanced Concepts and Greeen Chemistry (9 hrs)

Molecular switches and machines: Introduction to supramolecular chemistry, characteristics of molecular motors and machines. Rotaxanes and Catenanes as artificial molecular machines. Protypes linear motions in Rotaxanes, and acid-base controlled molecular shuttle, a molecular elevator, an autonomous light –powered molecular motors, natural molecular motors and machine.

Green chemistry: Principles of green chemistry, green synthesis – aqueous phase, microwave assisted chemical reactions and phase transfer catalysis (PTC).

Unit-5: Spectroscopic Techniques & Non-Conventional Energy Sources (10 hrs)

Spectroscopic Techniques: Electromagneticspectrum-types of molecular spectra and their absorption criteria.

UV-visible spectroscopy (electronic spectroscopy), Frank-Condon principle, Beer-Lambert's law and its limitations, chromophores and auxochromes – *applications of UV visible spectroscopy.

IR spectroscopy – functional group and finger print region – molecular vibrations – stretching and bending vibrations – *applications of IR.

NMR (Nuclear magnetic resonance): Working principle and instrumentation of NMR – chemical shift(δ) – *applications of NMR.

(*only general applications – without any spectroscopic problems regarding quantitative and qualitative analysis.)

Non-conventional energy sources: Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, organic photo-voltaic, hydropower, geothermal power, tidal, ocean thermal energy conversion (OTEC) – open cycle OTEC, closed cycle OTEC and hybrid cycle OTEC.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 explain the preparation, properties and applications of thermoplastics, thermosettings, elastomers and conducting polymers.

CO2 know the importance of various materials and their uses in the construction of batteries and fuel cells

CO3 know the applications of advanced materials in various industries

CO4 apply the principles of supramolecular chemistry in the applications of molecular machines, need of green chemistry.

CO5 explain the principles of spectrometry such as UV, IR, and NMR

Text books:

1. Engineering Chemistry by Jain & Jain; Dhanpat Rai Publicating Co., Latest Edition
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 Edition.
3. Engineering Chemistry by Prasanth Rath, B. Ramadevi, Ch. Venkata Ramana Reddy, Subendu Chakravarthy; Cengage Publications, 2019 Edition.

Reference books:

1. A text book of Engineering Chemistry by S.S. Dara, S. S. Umare; S. Chand & Co., Ltd., Latest Edition.
2. Engineering Chemistry by Shashi Chawla; Dhanpat Rai Publicating Co., Latest Edition.

I-Year-I Semester	Basic Electrical and Electronics Engineering	L	T	P	C
20EE1T01		2	1	0	3

Course objectives:

The main objectives are

1. To introduce basics of electric circuits and to teach DC and AC electrical circuit analysis.
2. To explain the working principles DC machines and speed control of various DC motors.
3. To explain the working principles of transformers and AC machines and its applications.
4. To introduce the basics of semiconductor physics and operation and applications of Diodes.
5. To introduce the basics of transistors and explain the transistor configurations.

Unit – 1: DC & AC Circuits (10 hrs)

DC Circuits: Electrical circuit elements (R - L and C) – Kirchhoff's laws -Voltage and Current division rules-series, parallel circuits, and star-delta and delta-star transformations- [Elementary treatment only]

AC Circuits: Representation of sinusoidal waveforms - Peak and RMS values - phasor representation - real power - reactive power - apparent power - power factor.[Elementary treatment only]

Unit-2: DC Machines (10 hrs)

DC Generator: Construction-Principle and operation of DC Generator - EMF equation -Types– Applications [Elementary treatment only]

DC Motor: Principle and operation of DC Motor – types-Torque equation - Speed control of DC Motor-Brake test- Swinburne's test-Applications. [Elementary treatment only]

Unit-3: **AC Machines (10 hrs)**

Single Phase Transformer: Construction, Principle, and operation of Single-Phase Transformer –EMF Equation-Losses-Efficiency. [Elementary treatment only]

Three Phase Induction Motor: Construction- Principle and operation of three phase Induction Motor-Types- Applications. [Elementary treatment only].

Unit-4: IoT Semiconductor Devices (10 hrs)

Semiconductor Physics, PN Junction Diode & Zener Diode-characteristics-Applications: Rectifiers (Half Wave Rectifier & Full Wave Rectifier) [Elementary treatment only], Clippers and Clampers.

Unit-5: Bipolar Junction Transistors (8 hrs)
Construction and working of bipolar junction transistor, CB, CE and CC Configurations and characteristics. [Elementary treatment only], Transistors as amplifiers, op-amp basics.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Apply concepts of KVL/KCL in solving DC circuits.
CO2 Choose correct machine for a specific application.
CO3 Illustrate working principles of DC and AC Machines.
CO4 Describe working principles of diodes and transistors.
CO5 Understand the applications of diodes and transistors.

Text books:

1. D. P. Kothari and I. J. Nagrath- "Basic Electrical Engineering" - Tata McGraw Hill - 2010.
2. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference books:

1. L. S. Bobrow- "Fundamentals of Electrical Engineering" - Oxford University Press - 2011.
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.

I-Year-I Semester	Computer Engineering Workshop	L	T	P	C
20CS1L02		1	0	4	3

Course objectives:
The main objectives are

1. To make the students aware of the basic hardware components of a computer and installation of operating system.
2. To introduce Raptor Tool for flowchart creation.
3. Each student will familiar with Productivity tool: LaTeX and Microsoft (MS) office
4. To get knowledge in awareness of cyber hygiene that is protecting the personal computer from getting infected with the viruses, worms, and other cyber-attacks.
5. To introduce the usage of Productivity tools in crafting professional word documents, excel spreadsheets and power point presentations using open office tools.

Unit – 1: (10 hrs)
Simple Computer System: Central processing unit, the further need of secondary storage, Types of memory, Hardware, Software, and people. Peripheral Devices: Input, Output and storage, Data Preparation, Factors affecting input, Input devices, Output devices, Secondary devices, Communication between the CPU, and Input/ Output devices.
Unit-2: (9 hrs)
Problem Solving and Programming: Algorithm development, Flowcharts, Looping, some programming features, Pseudo code, the one-zero game, some structured programming concepts, documents. Programming Languages: Machine Language and assembly language, high -level and low-level languages, Assemblers, Compilers, and Interpreters
Unit-3: **(10 hrs)**
Operating systems: Introduction, Evolution of operating systems, Command Interpreter, Popular operating systems- Microsoft DOS, Microsoft Windows, UNIX, and Linux.
Introduction to Unix Shell Commands, directory management commands, file operations, users commands, Time and Date commands.
Unit-4: (9 hrs)
Computer Networks: Introduction to computer Networks, Network topologies- Bus topology, star topology, Ring topology, Mesh topology, Hybrid topology, Types of Networks: Local area Network, Wide Area Networks, Metropolitan Networks, Campus/ Corporate Area Network, Personal Area Network, Network

Devices- Hub, Repeater, Switch, Bridge, Router, Gateway, Network interface Card, Basic Networking Commands.

Unit-5: (10 hrs)

Introduction to HTML : Basics in Web Design, Brief History of Internet ,World Wide Web Why create a web site ,Web Standards, HTML Documents ,Basic structure of an HTML document Creating an HTML document ,Mark up Tags ,Heading-Paragraphs ,Line Breaks ,HTML Tags.

Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia ,Working with Forms, and controls.

List of Tasks

TASK 1: PC Hardware: PC Hardware introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux, and the required device drivers. In addition hardware and software level troubleshooting process, tips and tricks would be covered.

Every student should identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. Every student should disassemble and assemble the PC back to working condition.

TASK 2: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition.

Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition.

TASK 3: **Drawing flowcharts (Raptor Tool)**

1. Create flowcharts for take-off landing of an Aeroplane.
2. Create a flowchart to validate an email id entered by user.
3. Create flowchart to print first 50 prime numbers.

TASK 4: Productivity tool: LaTeX and Microsoft (MS) office: Importance of MS office, Details of the three tasks and features that should be covered in each, MS word, Power Point, Excel.

TASK 5: Operating System Installation: Every student should individually install operating system like Linux or MS windows on the personal computer. The system should be configured as dual boot with both windows and Linux.

TASK 6: Basic Commands: Unix Shell Commands, directory management commands, file operations, users commands, Time and Date commands.

TASK 7: Orientation & Connectivity Boot Camp: Students should get connected to their Local A rea Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate how to access the websites and email.

TASK 8: Networking Commands:
ping, ssh, ifconfig, scp, netstat, ipstat, nslookup, traceroute, telnet, host, ftp, arp, wget, route

TASK 9: Basic HTML tags

1. Head Section and Elements of Head Section, Paragraphs, Formatting Styles.
2. Colour tags, Creating Hyperlinks, Images, Tables, lists
3. HTML Forms, Form Attributes, Form Elements.

TASK 10: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured. Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. Usage of search engines like Google, Yahoo, ask.com and others should be demonstrated by student.

TASK 11: Cyber Hygiene: Students should learn about viruses on the internet and install antivirus software. Student should learn to customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Identify various hardware components of a system and apply their knowledge about computer peripherals to identify / rectify problems onboard.

CO2 Assemble the computer.

CO3 Use various Microsoft tools.

CO4 Integrate the PCs into local area network and re-install operating system and various application programs.

CO5 Manage data backup and restore operations on computer and update application software.

Text books:

1. Fundamentals of Computers –Reema Thareja-Oxford higher education
2. Computer Fundamentals, Anita Goel, Pearson Education, 2017
3. PC Hardware Trouble Shooting Made Easy, TMH
4. Programming the World Wide Web, 7th Edition, Robet W Sebesta,

Pearson, 2013.

Reference books:

1. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, 2003.
2. An Introduction to Computer studies –Noel Kalicharan-Cambridge

I-Year-I Semester	Problem Solving using C	L	T	P	C
20CS1T01		2	1	0	3

Course objectives:

The main objectives are

1. To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2. To gain knowledge of the operators, selection, control statements and repetition in C
3. To learn about the design concepts of arrays, strings, enumerated structure, and union types. To learn about their usage.
4. To assimilate about pointers, dynamic memory allocation and know the significance of Pre-processor.
5. To assimilate about File I/O and significance of functions

Unit – 1: (11 hrs)

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes, and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

Unit-2: (9 hrs)

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples

Unit-3: (9 hrs)

Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages

Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code

Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application

Unit-4: (11 hrs)
Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value
Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application
Processor Commands: Processor Commands
Unit-5: (8 hrs)
Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion
Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions
Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand algorithms and basic terminology of C
CO2 Solve problems using control structures and modular approach
CO3 Demonstrate 1D and 2D arrays along with strings for linear data handling
CO4 Determine the use of pointers and structures
CO5 Implement various operations on data files.

Text books:

1. Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, CENGAGE
2. The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson

Reference books:

1. Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill
2. Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson
3. Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD

I-Year-I Semester	Applied Chemistry Lab	L	T	P	C
20SH1L04		0	0	3	1.5

Course objectives:

The main objectives are

1. To furnish the students with a solid foundation in Chemistry Laboratory required to solve the Engineering problems.
2. To expose the students in practical aspects of the theoritical concepts like pH, hardness of water etc.
3. To guide the students on how to handle the instruments like UV-visible spectrophotometer, potentiometer and conductometer.

List of Experiments

Students should do any 10 experiments listed below

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn (II) using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Copper (II) using standard EDTA solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Iron (III) by colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metric method).
9. Determination of concentration of strong acid vs strong base (by conductometric method).
10. Determination of strong acid vs strong base (by potentiometric method).
11. Determination of Mg^{+2} present in an antacid.
12. Determination of $CaCO_3$ presence in an egg shell.
13. Estimation of vitamin- C.
14. Determination of phosphoric content in soft drinks.
15. Adsorption of acetic acid by charcoal.
16. Prepatation of nylon-6, 6 and Bakelite (demonstration only)

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 estimate the amount of metal ions present in different solutions

CO2 analyze the quality parameters of water

CO3 determine the strength of different solutions by using different instrumentation techniques

Text books:

1. A Text Book of Quantitative Analysis, Arthur J. Vogel.

I-Year-I Semester	Basic Electrical and Electronics Engineering Lab	L	T	P	C
20EE1L01		0	0	3	1.5

Course objectives:
The main objectives are

1. To Verify Kirchhoff's laws, Voltage and Current division rules.
2. To learn speed control and testing of DC Shunt Motor.
3. To learn and understand the operation of induction motor.
4. To learn applications of diodes and transistors.

List of Experiments

Cycle-1

1. Verification of Kirchhoff laws.
2. Verification of Voltage division rule and current division rule.
3. Speed control of DC Shunt Motor.
4. Perform Brake test on DC Shunt Motor.
5. Conduct Swinburne's test on DC Shunt Motor.
6. Brake test on 3-phase Induction Motor.

Cycle-2

1. V-I characteristics of P-N Junction Diode.
2. Understand Zener Diode Characteristics.
3. Understand Half wave rectifier and Full wave rectifier with and without filter.
4. Characteristics of BJT in Common Base Configuration.
5. Characteristics of BJT in Common Emitter Configuration.
6. Zener diode as voltage regulator.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Verify Kirchhoff's Laws and voltage and current division rules for DC supply.
CO2 Analyze the performance of AC and DC Machines by testing.
CO3 Perform speed control of DC shunt motor.
CO4 Perform the half wave and full wave rectifier.

Text books:

1. D. P. Kothari and I. J. Nagrath- "Basic Electrical Engineering" - Tata McGraw Hill - 2010.
2. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, 9th

edition, PEI/PHI 2006.

Reference books:

1. L. S. Bobrow- “Fundamentals of Electrical Engineering” - Oxford University Press - 2011.
2. E. Hughes - “Electrical and Electronics Technology” - Pearson - 2010.

I-Year-I Semester	Problem Solving using C Lab	L	T	P	C
20CS1L01		0	0	3	1.5

Course objectives:

The main objectives are

1. Apply the principles of C language in problem solving.
2. To design flowcharts, algorithms and knowing how to debug programs.
3. To design & develop of C programs using arrays, strings pointers & functions.
4. To review the file operations, pre-processor commands.

List of Experiments

Exercise 1

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4

1 .Write a program in C to display the n terms of even natural number and their sum.

2. Write a program in C to display the n terms of harmonic series and their sum.

1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.

3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.

3. Write a program in C to sort elements of array in ascending order.

Exercise 6

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10

1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14

1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand & write the difference.
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Comprehend the various concepts of a C language
CO2 Develop algorithms and flowcharts
CO3 Design and development of C problem solving skills.
CO4 Acquire modular programming skills

I-Year-II Semester	Mathematics-II	L	T	P	C
20SH2T01		2	1	0	3

Course objectives:
The main objectives are
1. To elucidate the different numerical methods to solve nonlinear algebraic equations
2. To disseminate the use of different numerical techniques for carrying out numerical integration
3. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

Unit – 1: Iterative methods (9 hrs)
Introduction–Bisection method–Method of false position–Iteration method–Newton-Raphson method (one variable)–Jacobi and Gauss-Seidel methods for solving system of equations.
Unit-2: Interpolation (10 hrs)
Introduction–Errors in polynomial interpolation–Finite differences–Forward differences–Backward differences–Central differences –Relations between operators–Newton's forward and backward formulae for interpolation–Gauss's forward and backward formulae for
Interpolation – Interpolation with unequal intervals–Lagrange's interpolation formula–Newton's divide difference formula.
Unit-3: **Numerical integration and solution of ordinary difference equations (10 hrs)**
Trapezoidal rule–Simpson's $1/3^{rd}$ and $3/8^{th}$ rule–Solution of ordinary differential equations by Taylor's series–Picard's method of successive approximations–Euler's method–Modified Euler's method–Runge-Kutta method (second and fourth order).
Unit-4: Laplace Transforms (11 hrs)
Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function –Periodic function - Inverse Laplace transforms – Convolution theorem (without proof)
Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.
Unit-5: Fourier series and Fourier Transforms (8 hrs)
Fourier series: Introduction – Periodic functions – Fourier series of periodic

function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.
Fourier Transforms: Fourier integral theorem (without proof) - Fourier sine and cosine integrals – Sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Evaluate approximate in the roots of polynomial and transcendental equations by different algorithms

CO2 Solve system of linear algebraic equations using Gauss Jacobi, Gauss Seidel and apply Newton's forward and backward interpolation and Lagrange's formulae for equal and unequal intervals

CO3 Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations and also by Laplace the transforms for solving differential equations

CO4 Find or compute the Fourier series of periodic signals

CO5 Know and be able to apply integral expressions for the forwards and inverse Fourier transform to range of non-periodic waveforms

Text books:

1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

Reference books:

1. **B.V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. **H.K.Das,** Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

I-Year-II Semester	Applied Physics	L	T	P	C
20SH2T03		2	1	0	3

Course objectives:

The main objectives are

1. Impart Knowledge of Physical Optics phenomena like Interference and Diffraction required to design instruments with higher resolution.
2. Understand the physics of Semiconductors and their working mechanism for their utility in electronic devices.
3. Impart the knowledge of materials with characteristic utility in appliances.

Unit – 1: Wave Optics (10 hrs)

Interference: Principle of Superposition-Interference of light – Conditions for sustained Interference-Interference in thin films (reflected geometry) - Newton's Rings (reflected geometry) **Diffraction:** Fraunhofer Diffraction:- Diffraction due to single slit (quantitative), double slit(qualitative), N –slits(qualitative) and circular aperture (qualitative) – Intensity distribution curves - Diffraction grating – Grating spectrum – missing order– resolving power – Rayleigh's criterion – Resolving powers of Microscope(qualitative), Telescope(qualitative) and grating (qualitative).

Unit-2: LASERs and Holography (10 hrs)

LASERs: Interaction of radiation with matter – Spontaneous and Stimulated emission of radiation – population inversion – Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms - Ruby laser – Helium-Neon laser – Applications.

Holography: Introduction – principle – differences between photography and holography – construction and reconstruction of hologram – applications of holograms

Unit-3: **Magnetism and Dielectrics (10 hrs)**

Magnetism: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment - Bohr magneton-Classification of magnetic materials: Dia, para & Ferro – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – applications of Ferromagnetic material.

Dielectrics: Introduction- Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations: Electronic and Ionic (Quantitative), Orientation Polarizations (Qualitative) - Lorentz Internal field- Claussius – Mossotti's equation- Frequency dependence of polarization - Applications of dielectrics.

Unit-4: Quantum Mechanics (9 hrs)
Introduction– matter waves – de Broglie's hypothesis – Davisson-Germer experiment – G. P. Thomson experiment – Heisenberg's Uncertainty Principle– Schrödinger time independent and time dependent wave equations – physical significance of Schrödinger wave function – Particle in a potential box (determination of energy).

Unit-5: Semiconductor Physics (9 hrs)
Origin of energy bands (qualitative) –Classification of solids based on energy bands–Intrinsic semiconductors-density of charge carriers –Electrical conductivity-Fermi level – extrinsic semiconductors-P-type & N-type – Density of charge carriers- Dependence of Fermi energy on carrier concentration and temperature- Hall effect-Hall coefficient- Applications of Hall effect- Drift and Diffusion currents - Einstein's equation.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the principles such as interference and diffraction to design and enhance the resolving power of various optical instruments.

CO2 Learn the basic concepts of LASER light Sources and Apply them to holography

CO3 Study the magnetic and dielectric materials to enhance the utility aspects of materials.

CO4 Learn the fundamental concepts of Quantum behaviour of matter.

CO5 Identify the type of semiconductors using Hall Effect.

Text books:

1. "Engineering Physics" by B. K. Pandey, S. Chaturvedi - Cengage Publications, 2012
2. "A Text book of Engineering Physics" by M.N. Avadhanulu, P.G.Kshi S.Chand, 2017.
3. "Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxfo (2015).
4. "Engineering Physics" by R.K Gaur. and S.L Gupta., - Dhanpat Rai pu 2012.

Reference books:

1. "Engineering Physics" by M.R.Srinivasan, New Age international publishers (2009).
2. "Optics" by Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017.
3. "Solid State Physics" by A.J.Dekker, Mc Millan Publishers (2011).

I-Year-II Semester	Communicative English	L	T	P	C
20SH2T02		3	0	0	3

Course objectives:
The main objectives are

1. Adopt activity-based teaching-learning methods to ensure that learners would be engaged in use of language both in the classroom and laboratory sessions.
2. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
3. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
4. Help improve speaking skills through participation in activities such as role plays, discussions, and structured talks/oral presentations
5. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record, and report useful information
6. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Unit – 1: (10 hrs)
Detailed Study: A Proposal to Girdle the Earth (Excerpt) by Nellie Bly
Theme: Exploration
Listening: Identifying the topic, the context, and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies, and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Reading for Writing: Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.
Grammar and Vocabulary: Content words and function words; word forms: verbs, nouns, adjectives, and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form - wh-questions; word order in sentences.
Non-Detailed Study:
1. "How to Fashion Your Own Brand of Success" by Howard Whitman
2. "How to Recognize Your Failure Symptoms" by Dorothea Brande

Unit-2: (10 hrs)

Detailed Study: An excerpt from The District School as It Was by One Who Went to It by Warren Burton

Theme: On Campus

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar and Vocabulary: Cohesive devices - linkers, signposts, and transition signals; use of articles and zero article; prepositions.

Non-detailed Study:

3. "How to Conquer the Ten Most Common Causes of Failure" by Louis Binstock

4. "How to Develop Your Strength to Seize Opportunities" by Maxwell Maltz

Unit-3: (10 hrs)

Detailed Study: The Future of Work?

Theme: Working Together

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Grammar and Vocabulary: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Non-Detailed Study:

5. "How to Make the Most of Your Abilities" by Kenneth Hildebrand

6. "How to Raise Your Self-Esteem and Develop Self-confidence" by James W Newman

Unit-4: (10 hrs)

Detailed Study: H.G Wells and the Uncertainties of Progress by Peter J. Bowler

Theme: Fabric of Change

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role-plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes, or display complicated data.
Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.
Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms
Non-Detailed Study
7. "How to Win Your War against Negative Feelings" by Dr Maxwell Maltz
8. "How to Find the Courage to Take Risks" by Drs. Tom Rusk and Randy Read
Unit-5: (8 hrs)
Detailed Study: Leaves from the Mental Portfolio of a Eurasian by Sui Sin Far
Theme: Tools for Life
Listening: Identifying key terms, understanding concepts, and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.
Reading: Reading for comprehension.
Writing: Writing structured essays on specific topics using suitable claims and evidences
Grammar and Vocabulary: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Non-Detailed Study
9. "How to Become a Self-Motivator" by Charles T Jones
10. "How to Eliminate Your Bad Habits" by OgMandino

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English and formulate sentences using proper grammatical structures and correct word forms

CO2 speak clearly on a specific topic using suitable discourse markers in informal discussions

CO3 write summaries based on global comprehension of reading/listening texts

CO4 produce a coherent paragraph interpreting a figure/graph/chart/table

CO5 take notes while listening to a talk/lecture to answer questions

Text books:

1. English All Round: Communication Skills for Undergraduate Learners-Volume 1, Orient Black Swan, 2019
2. University of Success by OgMandino, Jaico, 2015.

Reference books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

AICTE Recommended Books

5. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Oxford University Press, 2018.
6. Pushplata and Sanjay Kumar. Communication Skills, Oxford University Press, 2018.
7. Kulbushan Kumar. Effective Communication Skills. Khanna Publishing House, Delhi

Sample Web Resources

Grammar / Listening / Writing

1-language.com

http://www.5minuteenglish.com/

https://www.englishpractice.com/

Grammar/Vocabulary

English Language Learning Online

http://www.bbc.co.uk/learningenglish/

http://www.better-english.com/

http://www.nonstopenglish.com/

https://www.vocabulary.com/

BBC Vocabulary Games

Free Rice Vocabulary Game

Reading

https://www.usingenglish.com/comprehension/

https://www.englishclub.com/reading/short-stories.htm
https://www.english-online.at/

Listening

https://learningenglish.voanews.com/z/3613
http://www.englishmedialab.com/listening.html

Speaking

https://www.talkenglish.com/
BBC Learning English – Pronunciation tips
Merriam-Webster – Perfect pronunciation Exercises

All Skills

https://www.englishclub.com/
http://www.world-english.org/
http://learnenglish.britishcouncil.org/

I-Year-II Semester	Problem solving using Python	L	T	P	C
20CS2T01		3	0	0	3

Course objectives:

The main objectives are

1. To learn about Python programming language syntax, semantics, and the runtime environment
2. To be familiarized with universal computer programming concepts like data types, containers
3. To be familiarized with general computer programming concepts like conditional execution, loops & functions
4. To be familiarized with general coding techniques and object-oriented programming

Unit – 1: (10 hrs)

Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.

Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

Unit-2: (9 hrs)

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration, While Loop

Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

Unit-3: **(9 hrs)**

List and Dictionaries: Lists, Defining Simple Functions, Dictionaries

Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function.

Modules: Modules, Standard Modules, Packages.

Unit-4: (10 hrs)

File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding, and retrieving dynamic attributes of classes, Programming using Oops support

Design with Classes: Objects and Classes, Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritance and Polymorphism

Unit-5: (10 hrs)

Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Programming: Introduction to Programming Concepts with Scratch.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Develop essential programming skills in computer programming concepts like data types, containers

CO2 Solve coding tasks related to conditions, loops, and String processing

CO3 Experiment with various Data structures in interpreted Language and to build modules and packages for real software needs.

CO4 Implement Files and object-oriented principles in Python

CO5 Identify solutions using GUI in Python.

Text books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
2. Python Programming: A Modern Approach, VamsiKurama, Pearson.

Reference books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Simple GUI-Based Programs and other useful GUI Resources
Introduction to Programming
Scratch Programming

I-Year-II Semester	Digital Logic Design	L	T	P	C
20EC2T03		2	1	0	3

Course objectives:

The main objectives are

1. To understand common forms of number representation in digital circuits and Boolean algebra.
2. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems and simplify logic expressions using basic theorems, K-map, and Tabular methods.
3. To understand the concept of Combinational logic design and realize logic expressions using MUXand Decoder
4. Illustrate the concept of sequential logic design; analyze the operation of flip-flop and conversion from one flip-flop to another, and application of flip-flop.
5. To impart to student the concepts of sequential machines of digital system.

Unit – 1: Number Systems and Boolean Algebra (10 hrs)

Number systems: Introduction to different number system and their conversions, complement of number system and subtraction using complement method, Floating-Point Representation, Weighted and Non-weighted codes and its properties.

Boolean Algebra: Boolean algebra and logic gates, Basic theorems and properties of Boolean Algebra, Boolean functions, canonical and standard forms, Universal Gates.

Unit-2: Minimization Methods of Boolean functions (8 hrs)

Minimization of logic expressions by algebraic method, Sum of Products (SOP), Product of Sums (POS), K-Map Method, Don't Care Combinations, Multilevel NAND/NOR realizations, Prime and essential Prime Implicants, Tabular Method, Prime Implicants Chart, Simplification Rules.

Unit-3: **Combinational Circuits (10 hrs)**

Design procedure, Half/full adders, Half / full subtractors, carry look ahead adder, BCD adder, Multiplexer/De-Multiplexer, Encoder/Decoder, Priority encoders, Implementation of Higher-Order Device Using Lower Order devices, Implementation of combinational logic using MUX/Decoder, Magnitude Comparator, Error detection and correction codes.

Unit-4: Sequential Circuits (10 hrs)

Sequential Circuits Fundamentals: Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master

Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Timing and Triggering Consideration, Conversion from one type of Flip-Flop to another.
Registers and Counters: Shift Registers Left, Right and Bidirectional Shift Registers, Applications of Shift Registers, Design and Operation of Ring and Twisted Ring Counter, Operation of Asynchronous and Synchronous Counters.

Unit-5: Sequential Machines (10 hrs)

Finite State Machines, Synthesis of Synchronous Sequential Circuits, Serial Binary Adder, Sequence Detector, Parity bit Generator, Synchronous Modulo N –Counters, Finite state machine capabilities and limitations, Mealy and Moore models.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Distinguish the analog and digital systems, apply positional notations, number systems, computer codes in digital systems.

CO2 Understand the Boolean Algebra theorems, simplify and design logic circuits.

CO3 Implemented combinational logic circuit design and modular combinational circuits using encoders, decoders, multiplexers and demultiplexers.

CO4 Understand the basic elements of sequential logic circuits.

CO5 Design and analyze sequential circuits.

Text books:

1. Digital Design by Mano, PHI
2. Modern Digital Electronics by RP Jain, TMH
3. Switching Theory and Logic Design by A. Anand Kumar, PHI.

Reference books:

1. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition
2. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers

I-Year-II Semester	Applied Physics Lab and Virtual Lab	L	T	P	C
20SH2L03		0	0	3	1.5

Course objectives:

The main objectives are

1. **Understand** the concepts of interference and diffraction and their applications.
2. **Apply** the concept of LASER in the determination of wavelength.
3. **Recognize** the importance of energy gap in the study of conductivity and Hall Effect.
4. **Illustrate** the magnetic and dielectric materials applications.
5. **Apply** the principles of semiconductors in various electronic devices.

LIST OF EXPERIMENTS

(Any 10 of the following listed 15 experiments)

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence.
2. Newton's rings – Radius of Curvature of Plano - Convex Lens.
3. Determination of thickness of a spacer using wedge film and parallel interference fringes.
4. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
5. Energy Band gap of a Semiconductor p - n junction.
6. Characteristics of Thermistor – Temperature Coefficients
7. Determination of dielectric constant by charging and discharging method
8. Variation of dielectric constant with temperature
9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
10. LASER - Determination of wavelength by plane diffraction grating
11. Determination of resistivity of semiconductor by Four probe method.
12. Determine the radius of gyration using compound pendulum
13. Rigidity modulus of material by wire-dynamic method (torsional pendulum)
14. Dispersive power of diffraction grating.
15. Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall Effect.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Operate optical instruments like microscope and spectrometer

CO2 Determine thickness of a paper with the concept of interference

CO3 Estimate the wavelength of different colours using diffraction grating and resolving power

CO4 Plot the intensity of the magnetic field of circular coil carrying current with distance

CO5 Calculate the band gap of a given semiconductor

I-Year-II Semester	Communicative English Lab	L	T	P	C
20SH2L03		0	0	3	1.5

Course objectives:
The main objectives are
1. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native and non-native speakers
2. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials like newspapers, magazines, periodicals, journals, etc.
3. Help improve speaking skills through participation in activities such as role plays, discussions, and structured talks/oral presentations
4. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record, and report useful information
5. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Introduction to Sound system of English
Articulation - Airstream mechanism, Manners of Articulation, Places of Articulation, English phonetic symbols.
Accent - Syllabification, word stress and accent, stress rules and stress shift, exceptions to rules.
Intonation - Stress and accent in connected speech. Types and functions of Intonation in English.
I. **A. Speaking**: Introducing Yourself and Others
B. Listening: Conversation between two and more people.
II. **A. Speaking:** Speak for a minute in response to a question about personal experience / wish.
B. Listening: Identifying the main idea of a talk or a conversation
III. **A. Speaking: Group discussion** – 5 minutes followed by a summary –1 or 2 minutes: Topics-1. Features that make a place beautiful, 2. The most challenging job you can think of, 3. Some skills that everyone should learn, 4. The best criteria to measure success, 5. A recent news story that is interesting, 6. Impact of technology on the music industry, 7. An app that has helped society, 8. Pros and Cons of after school tutorials, 9. How to stay safe on Social Media, 10. The most common reasons why friendships fall apart, 11. Interactions with seniors on campus, 12. Coping with peer pressure, 13. Others' opinion vs your belief, 14. Feeling that plants would express if they could, 15. Growing up alone vs Growing up with siblings, 16. Uniforms stifle individuality, 17. In India summer is the best and worst of times, 18. A good

sense of humour is a definite perk, 19. All fast food is not junk food and 20. Ideas to make your common room in college more inviting. Question Answer sessions – 1. Idea of a Tech Startup, 2. Training programme of T&P Cell, 3. Inter-college Cultural Fest, 4. 3-day Foreign University delegation visit to the campus, 5. Computer training programme by a reputed MNC, 6. Shifting your Dept or Classrooms to new location on campus, 7. How to manage attendance while attending additional courses (Minors/Honors), 8. How to choose placement offers? 9. Involvement in Student Affairs through SAC, 10. Planning an excursion.

B. Listening:1. Comprehension Exercise on Teamwork, 2. Predicting what the speaker would say from the title of the talk, 3. Comprehension based on a narrative or a short video, TED Talks

IV. **A. Speaking:** Preparing speech using picture clues, asking Q&A using pictures.

B. Listening: Listening Comprehension using short films, audio files, interviews of famous personalities

V. **A. Speaking:** Preparing 30-day planner, Using important phrasal expressions in speech, Oral Presentations on – 1. Setting goals is important2. Asking the right question is the skill you need to develop, 3. Do college students want their parents' attention4. Everyone needs to learn how to cook5. Doing household chores is everyone's responsibility 6. Study groups facilitate peer-monitoring7. Is it OK for students to do things just because they want to fit in? 8. Students should compulsorily make time for physical activity, 9. Taking breaks to pursue other interests improves academic performance, 10. Strategies to avoid stress, 11. How best to use the media for educational activities, 12. Why volunteer for service activities? 13. International student exchange programme, 15. Work-life balance 16. Strategies to build on your strength and overcome weaknesses, 17. Strategies to build confidence and self-esteem18. Procrastination kills opportunities, 19. Setting a budget and sticking to it, 20. Grooming and etiquette 21. Pros and Cons of being Competitive, 22. Virtual classroom vs real classroom, 23. Freedom brings more responsibility 24. To-do lists help you become more productive 25. Having a diverse group of friends is an asset 26. One thing you wish you had learnt in High school 27. Why is it important to be non-judgmental towards others? 28. Humans need empathy, 29. Public speaking is a necessary skill 30. How to build and maintain good professional relationships.

B. Listening: Listening Comprehension, Speeches by Famous personalities

Pair work, Role-play, conversational practice, and Individual speaking activities based on following essays from University of Success.

1. "How to Fashion Your Own Brand of Success" by Howard Whitman
2. "How to Recognize Your Failure Symptoms" by Dorothea Brande

3. “How to Conquer the Ten Most Common Causes of Failure” by Louis Binstock
4. “How to Develop Your Strength to Seize Opportunities” by Maxwell Maltz
5. “How to Make the Most of Your Abilities” by Kenneth Hildebrand
6. “How to Raise Your Self-Esteem and Develop Self-Confidence” by James W. Newman
7. “How to Win Your War against Negative Feelings” by Dr Maxwell Maltz
8. “How to Find the Courage to Take Risks” by Drs. Tom Rust and Randy Reed
9. “How to Become a Self-Motivator” by Charles T Jones
10. “How to Eliminate Your Bad Habits”by Og Mandino

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English and speak clearly on a specific topic using suitable discourse markers in informal discussions

CO2 take notes while listening to a talk/lecture; to answer questions in English; formulate sentences using proper grammatical structures and correct word forms; and use language effectively in competitive examinations

CO3 write summaries based on global comprehension of reading/listening texts; produce a coherent write-up interpreting a figure/graph/chart/table; and use English as a successful medium of communication.

Text books:
1. English All Round: Communication Skills for Undergraduate Learners-Volume 1, Orient Black Swan, 2019
2. University of Success by OgMandino, Jaico, 2015.

Reference books:
1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

AICTE Recommended Books
1. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Oxford

University Press, 2018.
2. Pushplata and Sanjay Kumar. Communication Skills, Oxford University Press, 2018.
3. Kulbushan Kumar. Effective Communication Skills. Khanna Publishing House, Delhi

Sample Web Resources

Grammar / Listening / Writing

1. 1-language.com
2. http://www.5minuteenglish.com/
3. https://www.englishpractice.com/

Grammar/Vocabulary

1. English Language Learning Online
2. http://www.bbc.co.uk/learningenglish/
3. http://www.better-english.com/
4. http://www.nonstopenglish.com/
5. https://www.vocabulary.com/
6. BBC Vocabulary Games
7. Free Rice Vocabulary Game

Reading

1. https://www.usingenglish.com/comprehension/
2. https://www.englishclub.com/reading/short-stories.htm
3. https://www.english-online.at/

Listening

1. https://learningenglish.voanews.com/z/3613
2. http://www.englishmedialab.com/listening.html

Speaking

1. https://www.talkenglish.com/
2. BBC Learning English – Pronunciation tips
3. Merriam-Webster – Perfect pronunciation Exercises

All Skills

1. https://www.englishclub.com/
2. http://www.world-english.org/
3. http://learnenglish.britishcouncil.org/

I-Year-II Semester	Problem solving using Python Lab	L	T	P	C
20CS2L01		0	0	3	1.5

Course objectives:

The main objectives are

1. To acquire programming skills in core Python.
2. To acquire Object Oriented Skills in Python
3. To develop the skill of designing Graphical user Interfaces in Python
4. To develop the ability to write database applications in Python

List of Problems

1. Write a program that asks the user for a weight in kilograms and converts it to pounds. There are 2.2 pounds in a kilogram.
2. Write a program that asks the user to enter three numbers (use three separate input statements). Create variables called total and average that hold the sum and average of the three numbers and print out the values of total and average.
3. Write a program that uses a *for* loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89.
4. Write a program that asks the user for their name and how many times to print it. The program should print out the user's name the specified number of times.
5. Use a *for* loop to print a triangle like the one below. Allow the user to specify how high the triangle should be.
   ```
   *
   **
   ***
   ****
   ```
6. Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not.
7. Write a program that asks the user for two numbers and prints *Close* if the numbers are within .001 of each other and not close otherwise.
8. Write a program that asks the user to enter a word and prints out whether that word contains any vowels.
9. Write a program that asks the user to enter two strings of the same length. The program should then check to see if the strings are of the same length. If they are not, the program should print an appropriate message and exit. If they are of the same length, the program should alternate the characters of the two strings. For example, if the user enters *abcde* and *ABCDE* the program should print out *AaBbCcDdEe*.Write a program that asks the user for a large integer and inserts commas into it according to the standard

American convention for commas in large numbers. For instance, if the user enters 1000000, the output should be 1,000,000.

10. In algebraic expressions, the symbol for multiplication is often left out, as in 3x+4y or 3(x+5). Computers prefer those expressions to include the multiplication symbol, like 3*x+4*y or 3*(x+5). Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate.
11. Write a program that generates a list of 20 random numbers between 1 and 100.
    a. Print the list.
    b. Print the average of the elements in the list.
    c. Print the largest and smallest values in the list.
    d. Print the second largest and second smallest entries in the list
    e. Print how many even numbers are in the list.
12. Write a program that asks the user for an integer and creates a list that consists of the factors of that integer.
13. Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row. For instance, the longest run of zeros in [1,0,1,1,0,0,0,0,1,0,0] is 4.
14. Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list [1,1,2,3,4,3,0,0] would become [1,2,3,4,0].
15. Write a program that asks the user to enter a length in feet. The program should then give the user the option to convert from feet into inches, yards, miles, millimeters, centimeters, meters, or kilometers. Say if the user enters a 1, then the program converts to inches, if they enter a 2, then the program converts to yards, etc. While this can be done with if statements,it is much shorter with lists and it is also easier to add new conversions if you use lists.
16. Write a function called *sum_digits* that is given an integer num and returns the sum of the digits of num.
17. Write a function called *first_diff* that is given two strings and returns the first location in which the strings differ. If the strings are identical, it should return -1.
18. Write a function called *number_of_factors* that takes an integer and returns how many factors the number has.
19. Write a function called *is_sorted* that is given a list and returns True if the list is sorted and False otherwise
20. Write a function called root that is given a number x and an integer n and returns $x^{1/n}$. In the function definition, set the default value of n to 2.

21. Write a function called primes that is given a number n and returns a list of the first n primes. Let the default value of n be 100.
22. Write a function called merge that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list.
    a. Do this using the sort method. b) Do this without using the sort method.
23. Write a program that asks the user for a word and finds all the smaller words that can be made from the letters of that word. The number of occurrences of a letter in a smaller word can't exceed the number of occurrences of the letter in the user's word.
24. Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
25. Write a program that reads a list of temperatures from a file called *temps.txt*, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt.
26. Write a class called Product. The class should have fields called name, amount, and price, holding the product's name, the number of items of that product in stock, and the regular price of the product. There should be a method *get_price* that receives the number of items to be bought and returns the cost of buying that many items, where the regular price is charged for orders of less than 10 items, a 10% discount is applied for orders of between 10 and 99 items, and a 20% discount is applied for orders of 100 or more items. There should also be a method called *make_purchase* that receives the number of items to be bought and decreases amount by that much.
27. Write a class called Time whose only field is a time in seconds. It should have a method called *convert_to_minutes* that returns a string of minutes and seconds formatted as in the following example: if seconds is 230, the method should return '5:50'. It should also have a method called *convert_to_hours* that returns a string of hours, minutes, and seconds formatted analogously to the previous method.
28. Write a class called Converter. The user will pass a length and a unit when declaring an object from the class—for example, c = Converter(9,'inches'). The possible units are inches, feet, yards, miles, kilometers, meters, centimeters, and millimeters. For each of these units there should be a method that returns the length converted into those units. For example, using the Converter object created above, the user could call c.feet() and should get 0.75 as the result.
29. Write a Python class to implement pow(x, n).
30. Write a Python class to reverse a string word by word.

31. Write a program that opens a file dialog that allows you to select a text file. The program then displays the contents of the file in a textbox.
32. Write a program to demonstrate Try/except/else.
33. Write a program to demonstrate try/finally and with/as.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Comprehend how software easily to build right out of the box.

CO2 Demonstrates the use of an interpreted language for problem solving through control statements including loops and conditionals.

CO3 Practice with data structures for quick programming solutions.

CO4 Demonstrates software building for real needs by breaking out code into reusable functions and modules.

CO5 Comprehend the software reliability through exception handling.

I-Year-II Semester	Environmental Science	L	T	P	C
20SH2N02		2	0	0	0

Course objectives:

The main objectives are

1. To make the students to get awareness on environment,
2. to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
3. to save earth from the inventions by the engineers.

Unit – 1: Multidisciplinary Nature of Environmental Studies (9 hrs)

Definition, Scope, and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Unit-2: Ecosystems, Biodiversity, and Its Conservation (9 hrs)

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers, and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure, and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation : Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-3: **Environmental Pollution and Solid Waste Management (10 hrs)**

Environmental Pollution: Definition, Cause, effects, and control measures of :

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects, and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, and landslides.

Unit-4: Social Issues and the Environment (10 hrs)

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

Unit-5: Human Population and the Environment (10 hrs)

Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the concepts of the ecosystem

CO2 Understand the natural resources and their importance

CO3 Learn the biodiversity of India and the threats to biodiversity, and apply conservation practices

CO4 Learn various attributes of the pollution and their impacts

CO5 Understand Social issues both rural and urban environment

Text books:

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson education
3. Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

Reference books:

1. Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2. Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
4. Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Prentice Hall of India Private limited.
5. A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Publishing House
6. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela-Prentice Hall of India Private limited.

II-Year-I Semester	Mathematics – III	L	T	P	C
20SH3T01		2	1	0	3

Course objectives:

The main objectives are

1. Instruct the concept of Matrices in solving linear algebraic equations.
2. Familiarize the techniques in partial differential equations.
3. Furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

Unit–1: Solving system of linear equations, Eigen values and Eigen Vectors (10 hrs)

Rank of a matrix by Echelon form and normal form–solving system of homogeneous and non-homogeneous linear equations–Gauss elimination, Gauss Jordan for solving system of equations- Eigen values and Eigen vectors and their properties

Unit–2: Cayley-Hamilton theorem and quadratic forms (10 hrs)

Cayley-Hamilton theorem (without proof)–Finding inverse and power of a matrix by Cayley-Hamilton theorem–Reduction to Diagonal form–Quadratic forms and nature of the quadratic forms–Reduction of quadratic form to canonical forms by orthogonal transformation.

Application: Free vibration of two mass systems.

Unit–3: Vector Differentiation (8 hrs)

Scalar and Vector point functions-Vector Differential operator- Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator-Vector identities- Scalar Potential.

Unit–4: Vector Integration (10 hrs)

Line integral – Work done – Circulation- Surface integral- Volume integral

Vector integral theorems (without proof): Green's theorem in a plane- Stokes theorem- Gauss Divergence theorem.

Unit–5: Solutions of Partial differential Equations (10 hrs)

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 develop the use of matrix algebra techniques that is needed by engineers for practical applications

CO2 solve system of linear algebraic equations using Gauss elimination, Gauss Jordan

CO3 to interpret the physical meaning of different operators such as gradient, curl and divergence

CO4 estimate the work done against a field, circulation and flux using vector calculus

CO5 identify the solution methods for partial differential equation that model physical processes

Text books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

Reference books:

1. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
2. H.K. Das, Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

e-resources:

1. https://www.freebookcentre.net/maths-books-download/Linear-Algebra-A-free-Linear-Algebra-Textbook-and-Online-Resource.html

II-Year-I Semester	Mathematical Foundations of Computer Science	L	T	P	C
20CO3T01		2	1	0	3

Course objectives:
The main objectives are
1. Introduce concepts of mathematical logic.
2. Introduce concepts and perform operations with sets, relations, and functions.
3. Solve counting problems by applying elementary counting techniques.
4. Introduce algebraic structures, generating functions and recurrence relations.
5. Use graph theory for solving problems.

Unit–1: Mathematical Logic & Predicate Calculus (8 hrs)
Mathematical Logic: Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, and Indirect Method of Proof.
Predicate Calculus: Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.
Unit–2: Set Theory & Relations (10 hrs)
Set Theory: Introduction, Operations on Binary Sets, Principle of Inclusion and Exclusion.
Relations: Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams, Functions: Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice, and its Properties.
Unit–3: Algebraic Structures and Number Theory (10 hrs)
Algebraic Structures: Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism.
Number Theory: Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, and Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic (Fermat's Theorem and Euler's Theorem)
Unit–4: Combinatorics & Recurrence Relations (10 hrs)
Combinatorics: Binomial and Multinomial Coefficients, Binomial and Multinomial Theorems, Pigeonhole Principle, and its Application.

Recurrence Relations: Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving non homogeneous Recurrence Relations.

Unit–5: Graph Theory (10 hrs)

Graph Theory: Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths, and Circuits, Eulerian and Hamiltonian Graphs, Multi graphs, Planar Graphs, Euler's Formula, Graph Colouring, Chromatic Number, Spanning Trees, Algorithms for Spanning Trees (Problems Only and Theorems without Proofs).

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Apply mathematical logic to solve problems

CO2 Understand sets, relations, and discrete structures

CO3 Apply number theory to perform modulo arithmetic and computer arithmetic.

CO4 Solve problems on recurrence relations and counting principles.

CO5 Analyse and solve real world problems using graphs and trees.

Text books:

1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu, and D. P.Mohapatra, 3rdEdition, Tata McGraw Hill.
3. Discrete Mathematics and its Applications with Combinatorics and Graph Theory, K. H.Rosen, 7th Edition, Tata McGraw Hill.

Reference books:

1. Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel,T.P. Baker, 2nd Edition, Prentice Hall of India.
2. Discrete Mathematical Structures, Bernand Kolman, Robert C. Busby, Sharon CutlerRoss, PHI.
3. Discrete Mathematics, S. K. Chakraborthy and B.K. Sarkar, Oxford, 2011

e-resources:

1. https://nptel.ac.in/courses/106/103/106103205/
2. https://nptel.ac.in/courses/106/106/106106183/

II-Year-I Semester	Data Structures	L	T	P	C
20CO3T02		3	0	0	3

Course objectives:

The main objectives are

1. Impart the usage of linear list to students.
2. Help students understand the difference between dynamic memory using linked list.
3. Demonstrate the students about the operations Trees.
4. Make the student to understand various algorithms in graphs.
5. Make the students to learn the importance of hashing and sorting algorithms.

Unit–1: Algorithms and Linear Lists (10 hrs)

Algorithmic complexity, performance and Analysis, Linear lists (Arrays), Applications of Linear List: Searching and Sorting

Unit–2: Stacks and Queues, Linked Lists (10 hrs)

Single Linked List, Double Linked List, Circular Linked List, Stack and Queues using linked list

Unit–3: Trees (10 hrs)

Binary Trees Operations, Tree traversal, Threaded Binary Trees, Binary Search Trees, Binary Heap

Unit–4: Graphs (10 hrs)

Elementary Graph Operations, Graph Traversals, Minimum cost spanning tree Algorithms, Shortest paths algorithms.

Unit–5: Hashing and Pattern Matching (8 hrs)

Concept Hashing, Hash Functions, Collision Resolution Techniques, Pattern Matching algorithms

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 comprehend the implementation of linear lists

CO2 examine static and dynamic data structures with suitable applications.

CO3 determine trees applications.

CO4 appreciate the importance and significance of graph algorithms in building and solving real world applications.

CO5 comprehend and implement algorithms for text processing

Text books:

1. Data structures, Algorithms and Applications, S. Sahni, University Press

(India) Pvt. Ltd, 2nd edition, Universities Press, Pvt. Ltd.
2. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education. Ltd, Second Edition

Reference books:

1. Data Structures and Algorithms, A. V. Aho, J. E. Hopcroft, and J. D. Ullman, Pearson, 2002.
2. Introduction to Algorithms, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press. 3rd Edition.
3. Classical Data Structures, 2nd Edition, Debasis Samanta, PHI

e-resources:

- Data Structures Visualizations : https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
- Code Archery Youtube Channel: https://www.youtube.com/playlist?list=PLrKBFf87Cy9CNZpzi3poq8BFWc0h4f0vL

II-Year-I Semester	Java Programming	L	T	P	C
20CO3T03		3	0	0	3

Course objectives:

The main objectives are

1. understand object-oriented programming concepts, and apply them in solving problems.
2. make the students to learn the principles of inheritance and polymorphism; and to demonstrate how they relate to the design of abstract classes; to introduce the implementation of packages and interfaces.
3. make the students to learn the concepts of exception handling.
4. make the students to learn the concepts of multithreading.
5. make the students to develop GUI applications.

Unit–1: Introduction to OOPS Concepts, Classes, and Strings (8 hrs)

Introduction to Object Oriented Programming, Java buzzwords, Java Programming Basics, Sample programs, Data types and operators, Control statements.

Classes: Classes, Objects, Methods, Constructors, this and static keywords, Method and Constructor Overloading, Access modifiers, arrays-One Dimensional and multi-dimensional arrays, Searching, Sorting.

Strings- Exploring the String class, String buffer class, Command-line arguments

Unit–2: Inheritance, Interfaces, Packages (10 hrs)

Inheritance: Need of inheritance, types, super keyword, abstract classes, interfaces, compile time and runtime polymorphism, Packages.

Unit–3: Exception Handling and I/O Streams (10 hrs)

Exception Handling: Concepts of Exception handling, Built-in exceptions, creating own exception sub classes, Assertions.

Stream based I/O (java.io) – The Stream Classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing Files, Random access file operations, Object Serialization, exploring java.nio

Unit–4: Multithreading (10 hrs)

Multithreading : Concepts of Multithreading, differences between process and thread, thread life cycle, Thread class, Runnable interface, creating multiple threads, Synchronization, thread priorities, inter thread communication, daemon threads, thread groups.

Unit–5: GUI Programming (10 hrs)
GUI Programming with Swing: Introduction, limitations of AWT, Various swing components & hierarchy.
Event Handling- event delegation model, sources of event, Event Listeners, adapter classes, inner classes.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Comprehend object-oriented programming concepts for problem solving.
CO2 Build class hierarchy and packages for real world problems.
CO3 Develop thread safe Java programs with appropriate Exception handling.
CO4 Demonstrate multithreaded application programs through a language
CO5 Design GUI applications using swings and multithreading.

Text books:

1. Java - The Complete Reference, Herbert Schildt, MC GRAW HILL Education, 9 th Edition, 2016.

Reference books:

1. "Java – How to Program," Paul Deitel, Harvey Deitel, PHI.
2. "Core Java," Nageswar Rao, Wiley Publishers.
3. "Thinking in Java," Bruce Eckel, Pearson Education
4. "A Programmers Guide to Java SCJP," Third Edition, Mughal, Rasmussen, Pearson.

e-resources:

- https://www.coursera.org/courses?query=java
- https://www.coursera.org/courses?_facet_changed_=true&query=java%20programming
- https://nptel.ac.in/courses/106/105/106105191/

II-Year-I Semester	Data Communications and Networking for IoT	L	T	P	C
20CO3T04		3	0	0	3

Course objectives:
The main objectives are
1. Study the basic taxonomy and terminology of the data communications & computer networking and enumerate the layers of OSI model and TCP/IP model.
2. Familiarize with the concepts of signals, transmission, and its components.
3. Study data link layer concepts, design issues, and protocols
4. Gain core knowledge of Network layer routing protocols and IP addressing
5. Study transport layer services, protocols, and acquire knowledge of application layer paradigms and protocols.

Unit–1: Introduction to data communications and Network Models (8 hrs)
Data Communications, Networks, The Internet, Protocols and Standards.
Network Models: Layered tasks, layers in the OSI model, TCP/IP protocol suite.
Network Technologies: Ethernet, Token ring, Token bus, RF, Wi-Fi, Bluetooth, and Zigbee.
Unit–2: Physical Layer (10 hrs)
Data and Signals: Analog and Digital, periodic analog signals, digital signals, transmission impairment, data rate limits, performance.
Data Transmission: Digital-to-Digital Conversion, Analog-To-Digital Conversion, Transmission Modes, Multiplexing.
Transmission Media: Guided and Unguided transmission media.
Switching in Networks: Circuit, Packet, and Virtual Circuits (along with the structure of the switches).
Unit–3: Data Link Layer (10 hrs)
Error Detection and Correction: Block Coding, Linear Block Codes, Cyclic Codes, Checksum
Data Link Control: Framing, Error Control and Flow Control (For Both Noisy and Noiseless Channels). HDLC and Point-To-Point Networks.
Multiple Access: Random Access, Controlled Access, and Channelization. Wired LANs, Wireless LANs, and Connecting Devices
Unit–4: Network Layer (10 hrs)
Internet Protocol and Address Mapping: ICMP, ICMPv6, IGMP, Error Reporting, and Multicasting, Forwarding, Routing: Distance Vector and Link state, Unicast Routing Protocols. Multicast Routing Protocols.

Unit–5: Transport Layer and Internet Application (10 hrs)
Process-to-Process Delivery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control and Quality of Service (QoS), Sockets.
Application Layer: Domain Naming System (DNS), DNS in Internet, Resolution, Remote Logging, Electronic Mail(SMTP), POP and File Transfer. WWW and HTTP. Security Services, Message confidentiality and integrity, Digital Signature, Entity Authentication and key and certificates management, firewalls.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Illustrate the OSI and TCP/IP reference model.
CO2 Understand and explain the concept of signals, data transmission and switching networks.
CO3 Evaluate data communication link considering elementary concepts of data link layer for error detection and correction.
CO4 Implement routing and congestion control algorithms
CO5 Develop application layer protocols

Text books:

1. "Data Communications and Networking with TCP/IP Protocol Suite", Behrouz A. Forouzan, 6th edition, TMH.
2. "Data and Computer Communications," William Stallings, 10th edition, Pearson.
3. "Understanding Data Communication & Networks," William A. Shay, 3rd edition, BSP.

Reference books:

1. "Data Communications and Computer Networks," Prakash C. Gupta, 2nd edition, PHI.
2. "Computer Networks: A Systems Approach," Larry L. Peterson, Bruce S. Davie, 5th edition, Morgan Kauffman publisher.
3. "Computer Networking: A Top-Down Approach," Kurose James F., Ross Keith W., 6th edition, Pearson.

e-resources:

- https://nptel.ac.in/courses/106/105/106105183/
- https://www.coursera.org/learn/fundamentals-network-communications#syllabus
- https://www.coursera.org/specializations/computer-communications
- https://examradar.com/online-test/data-communication-and-networking-test/

II-Year-I Semester	Data Structures Lab	L	T	P	C
20CO3L02		0	0	3	1.5

Course objectives:
The main objectives are
1. Ability to apply computational thinking to a diverse set of problems.
2. Ability to adapt to new challenges and computational environments.
3. Proficiency in the design and implementation of algorithms.

Lab Prerequisites: Solve the following problems in **Hackerrank**
1. Time Conversion
2. Diagonal Difference
3. Stair case
4. Birthday Cake candles

UNIT I

1 Implement Binary Search using arrays
2 Implement Insertion Sort.
3 Implement Quick Sort
4 Implement Merge Sort
5 Implement Radix Sort
String Pairs
Anagram

UNIT II

6 Implement stack using arrays
7 Implement conversion of infix to postfix expression.
8 Implement queue using arrays.
9 Implement circular queue
10 Implement Singly Linked List
11 Implement Doubly Linked List
12 Implement Binary Heap Operations.
Minimize the Sum
Implement Expression Tree.

UNIT III

13 Implement Complete Binary Tree
14 Implement Binary Trees Traversal techniques (recursi
15 Implement Binary Search Tree
16 Implement Binary Heap Operations.

UNIT IV

17 Implement Graph and its operations

18 Implement Breadth First Search
19 Implement Depth First Search
20 Implement Prims' Algorithm
21 Implement Kruskal's Algorithm
Implement Island Strikes.
Implement Pawn Moves.

UNIT V

22 Implement Linear Probing on a dictionary.
23 Implement Separate Chaining.
24 Implement Brute Force Pattern Matching.
25 Implement Boyer Moore Pattern Matching.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Select the most appropriate data structure and defend the selection.
CO2 Appropriately solve a variety of computational problems.
CO3 Communicate their results and describe an algorithm.

II-Year-I Semester	Java Programming Lab	L	T	P	C
20CO3O03		0	0	3	1.5

Course objectives:
The main objectives are
1. write programs using abstract classes.
2. write programs for solving real world problems using java collection frame work.
3. write multithreaded programs.
4. design GUI application using swing controls.
5. introduce java compiler and eclipse platform
6. impart hands on experience with java programming.

Note:
- Mandatory to follow test driven development with Eclipse IDE empowered JUnit testing framework and code coverage plugin.
- The list suggests the minimum program set. Hence, the concerned staff is requested to add more problems to the list as needed.

List of Experiments
1. Create a class called Invoice that a hardware store might use to represent an invoice for an item sold at the store. An Invoice should include four pieces of information as instance variables-a part number (type String),a part description(type String),a quantity of the item being purchased (type int) and a price per item (double). Your class should have a constructor that initializes the four instance variables. Provide a set and a get method for each instance variable. In addition, provide a method named get Invoice Amount() that calculates the invoice amount (i.e., multiplies the quantity by the price per item), then returns the amount as a double value. If the quantity is not positive, it should be set to 0. If the price per item is not positive, it should be set to 0.0. Write a test application named Invoice Test that demonstrates class Invoice's capabilities. [CO1]
2. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, and type of EB connection (i.e., domestic, or commercial). Compute the bill amount using the following tariff. [CO1]

If the type of the EB connection is domestic, calculate the amount to be paid as follows:

a) First 100 units - Rs. 1 per unit

b) 101-200 units - Rs. 2.50 per unit
c) 201 -500 units - Rs. 4 per unit
d) > 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

a) First 100 units - Rs. 2 per unit
b) 101-200 units - Rs. 4.50 per unit
c) 201 -500 units - Rs. 6 per unit
d) > 501 units - Rs. 7 per unit

3. Create class Savings Account. Use a static variable annual Interest Rate to store the annual interest rate for all account holders. Each object of the class contains a private instance variable savings Balance indicating the amount the saver currently has on deposit. Provide method calculate Monthly Interest to calculate the monthly interest by multiplying the savings Balance by annual Interest Rate divided by 12 this interest should be added to savings Balance. Provide a static method modify Interest Rate that sets the annual Interest Rate to a new value. Write a program to test class Savings Account. Instantiate two savings Account objects, saver1 and saver2, with balances of $2000.00 and $3000.00, respectively. Set annual Interest Rate to 4%, then calculate the monthly interest and print the new balances for both savers. Then set the annual Interest Rate to 5%, calculate the next month's interest and print the new balances for both savers. [CO1]
4. Create a class called Book to represent a book. A Book should include four pieces of information as instance variables-a book name, an ISBN number, an author name, and a publisher. Your class should have a constructor that initializes the four instance variables. Provide a mutator method and accessor method (query method) for each instance variable. In addition, provide a method named getBookInfo that returns the description of the book as a String (the description should include all the information about the book). You should use this keyword in member methods and constructor. Write a test application named BookTest to create an array of object for 30 elements for class Book to demonstrate the class Book's capabilities. [CO1].
5. Write a JAVA program to search for an element in a given list of elements using binary search mechanism. [CO1]
6. Write a Java program that implements Merge sort algorithm for sorting and also shows the number of interchanges occurred for the given set of integers. [CO1]

7. rite a java program to make rolling a pair of dice 10,000 times and counts the number of times doubles of are rolled for each different pair of doubles. Hint: Math.random() [CO1].
8. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary. [CO1]
9. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape. [CO2]
10. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages. [CO1]
11. Write a Java Program to Handle Arithmetic Exceptions and InputMisMatchExceptions. [CO1]
12. Write a multi-threaded Java program to print all numbers below 100,000 that are both prime and Fibonacci number (some examples are 2, 3, 5, 13, etc.). Design a thread that generates prime numbers below 100,000 and writes them into a pipe. Design another thread that generates Fibonacci numbers and writes them to another pipe. The main thread should read both the pipes to identify numbers common to both. [CO3].
13. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number. [CO3].
14. Write a Java program that correctly implements the producer – consumer problem using the concept of inter-thread communication. [CO3].
15. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes. [CO1].
16. Write a Java program to build a Calculator in Swings/ [CO4]

17. Write a Java program to implement JMenu to draw all basic shapes using Graphics. [CO4]
18. Write a Java program to implement JTable and JTree. [CO4]
19. Write a Java program to implement JTabbedPane. [CO4]
20. Write a Java Program that implements a simple client/server application. The client sends data to a server. The server receives the data, uses it to produce a result and then sends the result back to the client. The client displays the result on the console. For ex: The data sent from the client is the radius of a circle and the result produced by the server is the area of the circle. [CO3]

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Develop programs for solving real world problems using java collection frame work

CO2 Develop and apply multithreaded programs in network applications

CO3 Develop GUI programs using swing controls in Java

II-Year-I Semester	Data Communications and Networking for IoT Lab	L	T	P	C
20CO3L04		0	0	3	1.5

Course objectives:

The main objectives are

1. Understand and apply different network commands
2. Analyze different networking functions and features for implementing optimal solutions.
3. Apply different networking concepts for implementing network solution
4. Implement different network protocols

List of Experiments

1. Implement the data link layer framing methods such as character stuffing and bit stuffing.
2. Write a C program to develop a DNS client server to resolve the given hostname.
3. Implement on a data set of characters the three CRC polynomials – CRC-12, CRC-16 and CRC-CCIP.
4. Implement Dijkstra's algorithm to compute the shortest path in a graph.
5. Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table art each node using distance vector routing algorithm
6. Take an example subnet of hosts. Obtain broadcast tree for it.
7. Write a client-server application for chat using UDP
8. Implement programs using raw sockets (like packet capturing and filtering)
9. Write a C program to perform sliding window protocol.
10. Get the MAC or Physical address of the system using Address Resolution Protocol.
11. Simulate the Implementing Routing Protocols using border gateway protocol (BGP)
12. Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.

List of additional experiments:

13. Obtain routing table at each node using distance vector routing algorithm.
14. Obtain broadcast tree for the given subnet of hosts.
15. Write a C program to determine the host Byte Order.
16. Write a program to set and get socket options.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Apply the basics of Physical layer in real time applications
CO2 Apply data link layer concepts, design issues, and protocols
CO3 Apply Network layer routing protocols and IP addressing
CO4 Implement the functions of Application layer and Presentation layer paradigms and Protocols

II-Year-I Semester	Introduction to Electronics Hardware and Software	L	T	P	C
20CO3C01		0	0	4	2

Course objectives:

The main objectives are

1. Gain knowledge of electronic components
2. Understand the concept on different digital electronics components and circuits.
3. Study about electronics and electrical devices
4. Familiarize student with the basic PCB designing concepts.
5. Study about different measuring and signal conditioning instruments.

Unit–1: General Electronics Building Blocks (10 hrs)

Study of resistors, capacitors, and inductor coils, Study of voltage and current rating of components

Description to Analog Electronics: Study of rectifier circuits, amplifiers, regulator ICs, Operational amplifiers, oscillators, clocks, ADC and DAC.

Unit–2: Description to Digital Electronics (10 hrs)

Role, Scope, and Components of Digital Electronics

Study of digital circuits and gates: Logic gates using transistors, study of logic gate ICs, truth table verification using logic gate ICs,

Description to combinational circuits: Adder, Mux, Demux, Encoder, Decoder, BCD to Seven Segment Encoder.

Description to sequential circuits: Flip-flops, Latches, Registers, Counters.

Unit–3: Power Supply Systems, electronic and electrical devices (8 hrs)

Concept of positive and negative power supply, Study of voltage step up/down concept, Description of filter and regulators, fixed and variable +ve and –ve supply.

Study of other electronics and electrical devices

Description to permanent DC motors, stepper, and servo motors

Concept of driving motors: H-bridge concept, High current driver ICs

Role of different motors in different applications: Robotic, door open/close, wheels driving.

Description to relays: Working mechanism, types of relays, controlling the motor direction.

Description of buzzer: Types, Piezoelectric, Mechanical, Interfacing buzzer, Uses of buzzer.

Description to optocoupler, applications.

Description to LEDs and Seven segment display: Types, common cathode, common anode.

Unit–4: Introduction to PCB Designing concepts (11 hrs)

Introduction & history: Types, PCB materials, Trends in designing, Component packaging types.

PCB designing flow chart, Description of PCB layers, study of IPC standards.

Unit–5: Study of measuring instruments and signal conditioning (9 hrs)

Measuring instruments

Types, CRO, DSO, Digital Multimeter.

Component interconnection and signal conditioning

Introduction, Impedance, Impedance matching methods, Amplifiers, Analog filters, Modulators and Demodulators, Data Acquisition hardware, Bridge circuits, Linearizing devices, Miscellaneous signal modification hardware.

Software's used:

For PCB designing: PCBWeb Designer, ZenitPCB, TinyCAD, Osmond PCB, BSch3V, Express PCB, Kicad, Fritzing, DesignSpark PCB, EasyEDA.

For simulation: ORCAD PSPICE, Tina Pro

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Identify and differentiate electronic components and designing simple analog circuits

CO2 Identify digital electronic components and designing simple digital circuits

CO3 Demonstrate the purpose of supply units and control of motor circuits.

CO4 Describe the process of preparing PCB as per standards

CO5 Use of instruments and conditioning devices for obtaining measurements.

Text books:

1. "Sensors and Actuators Engineering System Instrumentation," Clarence W de Silva, 2016, 2nd edition, CRC press.
2. "Electronic Circuit Design and Application," Gift, Stephan J.G., Maundy, Brent, 2021, Springer.
3. "Foundation of Digital Electronics and Logic Design", Subir Kumar Sarkar, Asish Kumar De, Souvik Sarkar, 2014, Pan Stanford Publishing
4. "Complete PCB Design Using OrCAD Capture and PCB Editor", Kraig Mitzner, 2009, Elsevier Science
5. "Electrical Measurement, Signal Processing, and Displays", John G. Webster, 2003, CRC Press

Reference books:

1. "PCB Design for Real-World EMI Control", Bruce R. Archambeault, James

Drewniak, 2013, Springer US

2. “Printed Circuit Board Design Using AutoCAD”, Chris Schroeder, 1998, Newnes
3. “Measurement, Instrumentation, and Sensors Handbook,” Halit Eren, John G. Webster, 2018, CRC Press.

e-resources:

1. http://www.emtech.in/courses/electronics-hardware-design-2/
2. https://www.udemy.com/course/mixed_signal_course_esteempcb/
3. https://www.udemy.com/course/electronic-circuits-for-beginners-analog-hardware-design/

II-Year-I Semester	Essence of Indian Traditional Knowledge	L	T	P	C
20SH3N01		2	0	0	0

Course objectives:

The main objectives are

1. Impart basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
2. Understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003
3. Focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection
4. Know the student traditional knowledge in different sector

Unit–1:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge.

Unit–2:

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit–3:

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act,

2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Unit–4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Unit–5:

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the concept of Traditional knowledge and its importance
CO2 Know the need and importance of protecting traditional knowledge
CO3 Know the various enactments related to the protection of traditional knowledge
CO4 Understand the concepts of Intellectual property to protect the traditional knowledge
CO5 Understand the importance of Intellectual property in different sectors

Text books:

1. "Traditional Knowledge System in India," Amit Jha, 2009, Atlantic publisher.
2. "Traditional Knowledge System and Technology in India," Basanta Kumar Mohantra, Vipin Kumar Singh, 2012, Pratibha Prakashan publisher.

Reference books:

1. "Knowledge Traditions and Practices of India," 2012, Kapil Kapoor, Michel Danino

e-resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

II-Year-II Semester	Probability and Statistics	L	T	P	C
20SH4T01		2	1	0	3

Course objectives:

The main objectives are

1. To Classify the concepts of data science and its importance
2. To Interpret the association of characteristics and through correlation and regression tools
3. To Understand the concepts of probability and their applications, apply discrete and continuous probability distributions
4. To Design the components of a classical hypothesis test
5. To Infer the statistical inferential methods based on small and large sampling tests

Unit–1: Descriptive statistics and methods for data science (9 hrs)

Data science-Statistics Introduction-Population vs Sample-Collection of data-primary and secondary data-Types of variables: dependent and independent Categorical and Continuous variables-Data visualization-Measures of Central tendency-Measures of Variability (spread or variance)-Skewness Kurtosis.

Unit–2: Correlation and Curve fitting (9 hrs)

Correlation-correlation coefficient-Rank Correlation-Regression coefficient and properties-regression lines-Multiple regression-Method of least squares-Straight line-parabola-Exponential-Power curves.

Unit–3: Probability and Distributions (10 hrs)

Probability-Conditional probability and Baye's Theorem-Random variables-Discrete and Continuous random variables-Distribution function-Mathematical Expectation and Variance-Binomial, Poisson, Uniform and Normal distributions.

Unit–4: Sampling Theory (10 hrs)

Introduction–Population and samples-Sampling distribution of Means and Variance (definition only)-Central limit theorem (without proof)-Point and Interval estimations, good estimator, Unbiased estimator, Efficiency estimator-Maximum error of estimate.

Unit–5: Test of Hypothesis (10 hrs)

Introduction–Hypothesis-Null and Alternative Hypothesis-Type I and Type II Errors-Level of significance-One tail and two-tail tests-Tests concerning one mean, two means, and proportions using Z test, Tests concerning one mean, two means using t test, also chi-square and F tests use for small samples.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Classify the concepts of data science and its importance
CO2 Understand the concepts of probability and their applications, & apply discrete and continuous probability distributions
CO3 Interpret the association of characteristics and through correlation and regression tools
CO4 Design the components of a classical hypothesis test
CO5 Infer the statistical inferential methods based on small and large sampling tests

Text books:
1. Miller and Freund's, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012

Reference books:
1. Shron L. Myers, Keying Ye, Ronald E Walpole, Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
2. Jay I. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. Sheldon M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011.
4. Johannes Ledolter and Robert V. Hogg, Applied statistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010.
5. T. K. V. Iyenger, Probability and Statistics, S. Chand & Company Ltd, 2015.

e-resources:
1. https://www.youtube.com/watchv=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE
   (For Probability and Statistics)
2. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB
   (For Probability and Statistics)
3. https://www.mathsisfun.com/data/standard-normal-distribution-table.html
   (Information about Normal distribution)
4. https://www.statisticshowto.com/tables/t-distribution-table/
   (Information about T- distribution)

Statistical Tables to be allowed in examinations:
a) Normal distribution table
b) T- distribution table

II-Year-II Semester	Computer Organization	L	T	P	C
20EC4T04		3	0	0	3

Course objectives:

The main objectives are

1. To understand basic structures of computers and to understand various machine instructions.
2. To understand basic structures of computers and to understand various machine instructions.
3. To analyse ALU & I/O organization of a computer.
4. To understand various memory systems.
5. To analyse functionalities done by processing unit and also learn micro programmed control.

Unit–1: Basic Structure of a Computer and Machine Instructions (8 hrs)

Introduction: Introduction, Functional unit, Basic Operational concepts, Bus structures, System Software, Performance. **Number Representation**: Integer - unsigned, signed (sign magnitude, 1's complement, 2's complement); Characters - ASCII coding, other coding schemes; Real numbers - fixed and floating point, IEEE754 representation. **Machine Instructions:** Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types

Unit–2: Addressing modes and types of Instructions (10 hrs)

Addressing Modes: Addressing Modes, Basic Input/output Operations, and role of Stacks and Queues in computer programming equation. **Components of Instructions:** Logical Instructions, shift, and Rotate Instructions. **Type of Instructions:** Arithmetic and Logic Instructions, Branch Instructions, Input, and output operations

Unit–3: Basic building blocks for the ALU (10 hrs)

Basic Building Blocks for the ALU: Adder, Subtracter, Shifter, Multiplication, and division circuits. **I/O Organization:** Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access. **Buses:** Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI) Bus, Universal Serial Bus (USB)

Unit–4: The Memory Systems (8 hrs)

Memory: Basic memory circuits, Memory System Consideration, Read- Only Memory: ROM, PROM, EPROM, EEPROM, Flash Memory, **Cache Memories:** Mapping Functions, Interleaving. **Secondary Storage:** Magnetic Hard Disks, Optical Disks.

Unit–5: Processing unit (12 hrs)

Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic Operation, Fetching a Word from Memory, Execution of Complete Instruction, Hardwired Control. **Micro Programmed Control:** Microinstructions, Micro program Sequencing, Wide Branch Addressing Microinstructions with next – Address Field. **Pipeline:** Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 comprehend basic structures of computers and to understand various machine Instructions

CO2 learn and use the addressing modes and types of instructions

CO3 analyze I/O organization of a computer.

CO4 comprehend various memory systems

CO5 analyze functionalities done by processing unit and also learn micro programmed control

Text books:

1. Computer Organization, Carl Hamacher, ZvonksVranesic, SafeaZaky, 5th Edition, McGraw Hill.
2. Computer Architecture and Organization by William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003

Reference books:

1. Computer Architecture and Organization, John P. Hayes, 3rd Edition, McGraw Hill.
2. Computer System Architecture by M Morris Mano, Prentice Hall of India, 2001

e-resources:

1. https://nptel.ac.in/courses/106/105/106105163/
2. http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf

II-Year-II Semester	Operating Systems	L	T	P	C
20CO4T01		3	0	0	3

Course objectives:
The main objectives are
1. Study the basic concepts and functions of operating system
2. Learn about Processes, Threads and Scheduling algorithms
3. Understand the principles of concurrency and Deadlocks
4. Learn various memory management schemes
5. Study I/O management and File systems

Unit–1: Introduction to Operating System Concepts (8 hrs)
What Operating Systems do, Computer System Organization, Functions of Operating systems, Types of Operating Systems, Operating Systems Services, System calls, Types of System calls, Operating System Structures, Distributed Systems, Special purpose systems

Unit–2: Process Management & Threads (10 hrs)
Process Management: Process concept, Process State Diagram, Process control block, Process Scheduling- Scheduling Queues, Schedulers, Scheduling Criteria, Scheduling algorithms and their evaluation, Operations on Processes, Inter-process Communication
Threads: Overview, User and Kernel threads, Multi-threading Models.

Unit–3: Concurrency & Principles of deadlock (10 hrs)
Concurrency: Process Synchronization, The Critical- Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Monitors, and Classic Problems of Synchronization.
Principles of deadlock: System Model, Deadlock Characterization, Methods for Handling Deadlocks: Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock.

Unit–4: Memory management & Virtual memory management (10 hrs)
Memory Management: Logical vs physical address space, Swapping, Contiguous Memory Allocation, Paging, Structures of the Page Table, Segmentation.
Virtual Memory Management: Virtual memory overview, Demand Paging, Page-Replacement & its algorithms, Allocation of Frames, Thrashing.

Unit–5: File system interface, implementation, and mass storage structure (10 hrs)
File system Interface: The concept of a file, Access Methods, Directory structure, files sharing, protection.
File System implementation: File system structure, Allocation methods, and

Free-space management.
Mass-storage structure: overview of Mass-storage structure, Disk scheduling, Swap space management.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the structure and functionalities of Operating System
CO2 Demonstrate the concept of Process, Threads and CPU Scheduling Algorithms
CO3 Use the principles of Concurrency to solve Synchronization problems and methods of deadlocks
CO4 Infer various Memory Management Techniques
CO5 Illustrate File System Implementation

Text books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley, and Sons Inc., 2012
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011

Reference books:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata McGraw-Hill Education

e-resources:

- https://en.wikipedia.org/wiki/Operating_system
- https://www.tutorialspoint.com/operating_system/

II-Year-II Semester	Database Management Systems	L	T	P	C
20CO4T02		3	0	0	3

Course objectives:
The main objectives are
1. Study the basic concepts and importance of Database Management Systems
2. Learn and understand the conceptual design of database and information retrieval
3. Learn various commands and writing of queries for information retrieval
4. Understand the concepts of Database design
5. Study of internal storage and its access.

Unit–1: Introduction (10 hrs)
Introduction to Database, Applications of Database, Purpose of Database, View of Data, Data Independence, Data Models, Users of Database, DBA, Query Processor, Storage Manager, Database Architecture

Unit–2: Conceptual Design & Relational Query Languages (10 hrs)
Conceptual Design of Database using ER Model, Notations, Types of attributes, Relation, Mapping Constraints, Features of ER Diagram, Weak Entity Set, Examples of Conceptual Design

Relational Algebra: Selection, Projection, Set Operations, Rename, Cartesian-Product, Join, Outer Join, Examples,

Relational Calculus: Tuple Relational Calculus and Domain Relational Calculus, Safety Expressions

Unit–3: SQL & PL/SQL (10 hrs)
SQL Commands: DDL, DML, TCL, DCL.

Types of Constraints (Primary, Alternate, Not Null, Check, Foreign), Basic form of SQL query, joins, outer joins, set operations, group operations, various types of queries, PL/SQL (Cursor, Procedures, Functions, Packages, Triggers…)

Unit–4: Database Design (10 hrs)
Database Design: Normalization, Purpose of Normalization, Functional Dependency, Closure, 1NF, 2NF, 3NF, BCNF, MVFD, 4NF, Join Dependency, 5NF

Why NoSQL? Importance of NoSQL

Unit–5: Transaction, Data Recovery & Storage Management (8 hrs)
Transaction Management: ACID Properties of Transactions, Conflict & View serializability, Lock based protocols, Time Stamp based protocol, Thomas Write Rule, Validation Based Protocol, Deadlock detection, Deadlock avoidance, Deadlock prevention: wait-die and wound-wait.

Recovery Management: Types of failures, ideal storage, Log, Log records, log-based recovery techniques, Shadow Paging, ARIES

File Organization & Indexing: Types of File Organizations, Primary Indexing, Secondary Indexing, Multi-level Indexing, Hash Indexing, Tree Indexing

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 comprehend the basics of database systems and applications

CO2 construct logical design of database and information retrieval

CO3 demonstrate relational model practically (Structured Query Language)

CO4 demonstrate and relate normalization for database design

CO5 outline the necessity of transaction management, recovery management, file organization & indexing

Text books:

1. Database System Concepts,5/e, Silberschatz, Korth, TMH
2. Introduction to Database Systems, CJ Date, Pearson

Reference books:

1. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, and TATA McGraw Hill 3rd Edition
2. Fundamentals of Database Systems, ElmasriNavate Pearson Education

II-Year-II Semester	Introduction to IoT	L	T	P	C
20CO4T03		3	0	0	3

Course objectives:
The main objectives are
1. Introducing the IoT related sensors, infrastructural and networking technologies.
2. Understand various modules and protocols used in IoT environment.
3. Understand the core technologies behind IoT.
4. Encourage analysis, design, and development of IoT applications.
5. Identify the real-world scenarios and apply the IoT solutions for a better solution.

Unit–1: Introduction (10 hrs)
Definition and Characteristics of IoT – IoT Architectures-Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.
Unit–2: Control units (9 hrs)
Communication modules – Bluetooth – Zigbee – Wi-Fi – GPS- IoT Application and Network Layer Protocols (IPv6, 6LoWPAN, RPL, CoAP, MQTT, AMQP, etc.), Wired Communication, Power Sources.
Unit–3: Four Pillars of IoT Paradigm (10 hrs)
RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IoT Enabling Technologies – Big Data Analytics, Cloud Computing, Embedded Systems.
Unit–4: IoT System Design (10 hrs)
Working principles of sensors – IoT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB - Contiki OS Cooja Simulator. Clustering, Clustering for Scalability, Clustering Protocols for IoT.
Unit–5: API Development Tools (9 hrs)
Python based API development, Set up cloud environment –Cloud access from sensors– Data Analytics for IoT- Case studies- Smart Healthcare – Smart Cities – Other recent projects.

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Identify the basic building blocks of Internet of Things.
CO2 Design and develop protocols and modules for IoT applications
CO3 Understand and implement the technologies required for the

development of IoT applications.

CO4 Implement applications based on sensors and other microcontroller boards.

CO5 Build cloud-based IoT applications in real-time.

Text books:

1. Architecting the Internet of Things, **Uckelmann**, Dieter, **Harrison**, Mark, **Michahelles**, Florian, 2011, Springer.
2. **IoT Security: Advances in Authentication , Madhusanka Liyanage, An Braeken, Pardeep Kumar, Mika Ylianttila, 2020 John Wiley & Sons Ltd , Print ISBN:9781119527923**
3. Internet of Things – A Hand-on Approach, Arshdeep Bahga and Vijay Madisetti, 2015, Universities press.

Reference books:

1. Building Internet of Things with the Arduino, Charalampos Doukas, 2002, Create space.
2. Internet of Things: From research and innovation to market deployment, Dr. Ovidiu Vermesan and Dr. Peter Friess, 2014, River Publishers.
3. Contiki: The open source for IOT, www.contiki-os.org

e-resources:

1. https://www.coursera.org/specializations/iot
2. https://www.edx.org/learn/iot-internet-of-things
3. https://nptel.ac.in/courses/106/105/106105166/

II-Year-II Semester	Computer Organization and IoT Lab	L	T	P	C
20EC4L03		0	0	3	1.5

Course objectives:
The main objectives are

1. Understand the working of logic families and logic gates
2. Interpreting the design of combinational and sequential circuits.
3. Understand the concept of IoT and its design procedures
4. Study the IoT concepts and its applications.

List of Experiments:
Related to computer organization

1. Realization of Boolean Expressions using Gates
2. Design and realization logic gates using universal gates
3. Design a JK Flip-Flop, Edge triggered J-K NAND Flip Flop and show its functionality Handle race condition and clock gating in your circuit.
4. Design a 4 – bit Adder / Subtractor
5. Combinational logic circuits: Implementation of Boolean functions using logic gates
6. Arithmetic operations using logic gates; Implementation of Multiplexers, Demultiplexers, Encoders, Decoders; Implementation of Boolean functions using Multiplexers/Decoders
7. Study of sequential logic circuits: Implementation of flip flops, Verify the excitation tables of various FLIP-FLOPS.

Related to IoT

8. Design and implementation of cloud based smart home automation system.
9. Real time monitoring of water level of storage tank using IoT.
10. IoT based smart agricultural monitoring and Irrigation system.
11. Intelligent gas leakage detection system with IoT
12. Design and implementation of IoT based smart power management system.
13. An IoT based human intrusion detection and alerting system.

List of additional experiments:

14. Design and realization a Synchronous and Asynchronous counter using flip-flops
15. Design and realization of an 8-bit parallel load and serial out shift register using flip flops
16. Implementation of counters, Design, and realization a Synchronous and Asynchronous counter using flip-flops

17. Design and realization of 4x1 mux, 8x1mux using 2x1 mux
18. Smart industry protection system using IoT.
19. IoT based smart health monitoring system.
20. IoT based fire accident alarming mechanism.
21. IoT based asses tracking mechanism.

Note: Experiments can be done using Logic board, EasyCPU, RTSlim, Little Man Computer (LMC), Arduino UNO, Arduino Nano, or NODEMCU using Arduino Open-Source IDE.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Know the characteristics of various components and logic circuits.
CO2 Realize and design of combinational and sequential circuits.
CO3 Demonstrate the implementation of IoT designs.
CO4 Develop the prototype models to solve real time problems.

Text books:

1. "Building Arduino Projects for the Internet of Things-Experiments with Real World Applications," Adeel Javed, 2016, Apress
2. "The Internet of Things-Do it Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black," Donald Norris, 2015, TMH.

e-resources:

1. http://vlabs.iitkgp.ernet.in/coa/#
2. https://iotify.io/iot-virtual-lab/
3. https://iot4beginners.com/iot-virtual-lab/

II-Year-II Semester	Operating Systems Lab	L	T	P	C
20CO4L02		0	0	3	1.5

Course objectives:

The main objectives are

1. Ability to apply computational thinking to a diverse set of problems.
2. Ability to analyse the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS.
3. Proficiency in the design and implementation of algorithms

List of Experiments

1. Simulate the following CPU scheduling algorithms [CO1]
    a. FCFS
    b. SJF (Premptive, Non Premptive)
    c. Priority (Premptive, Non Premptive)
    d. Round Robin
2. Simulate the following Process Synchronization techniques [CO1]
    a. Bounded-Buffer problem
    b. Readers-Writers problem
    c. Dining philosophers problem using semaphores
    d. Dining-Philosophers Solution using Monitors
3. Simulate Bankers Algorithm for [CO1]
    a. Dead Lock Avoidance
    b. Dead Lock Prevention
4. Simulate the following page replacement algorithms. [CO2]
    a. FIFO
    b. LRU
    c. LFU
    d. MFU
5. Simulate the following [CO2]
    a. Multiprogramming with a fixed number of tasks (MFT)
    b. Multiprogramming with a variable number of tasks (MVT)
6. Simulate the following File allocation strategies [CO3]
    a. Contiguous
    b. Linked
    c. Indexed
7. Simulate the following disk-scheduling algorithms [CO3]
    a. FCFS
    b. SSTF
    c. SCAN

d. C-SCAN
e. LOOK
f. C-LOOK

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Examine various process management techniques like CPU scheduling, process synchronization and deadlocks

CO2 Prioritize various memory management techniques like page replacement algorithms

CO3 Analyse various storage management techniques like file allocation and disk scheduling

II-Year-II Semester	Database Management Systems Lab	L	T	P	C
20CO4L01		0	0	3	1.5

Course objectives:
The main objectives are

1. Familiarize the participant with the distinctions of database environments towards an information-oriented framework
2. Give a good formal foundation on the relational model of data
3. Present SQL and procedural interfaces to SQL comprehensively.

List of Experiments
SQL

1. Queries for Creating, Dropping, and Altering Tables, Views, and Constraints [CO1]
2. Queries to facilitate acquaintance of Built-In Functions, String Functions, Numeric Functions, Date Functions and Conversion Functions. [CO1]
2. Queries using operators in SQL [CO2]
3. Queries to Retrieve and Change Data: Select, Insert, Delete, and Update [CO2]
4. Queries using Group By, Order By, and Having Clauses [CO2]
5. Queries on Controlling Data: Commit, Rollback, and Save point [CO2]
6. Queries to Build Report in SQL *PLUS [CO2]
7. Queries on Joins and Correlated Sub-Queries [CO2]
8. Queries on Working with Index, Sequence, Synonym, Controlling Access, and Locking Rows for Update, Creating Password and Security features [CO2]

PL/SQL

1. Write a PL/SQL Code using Basic Variable, Anchored Declarations, and Usage of Assignment Operation [CO3]
2. Write a PL/SQL Code Bind and Substitution Variables. Printing in PL/SQL [CO3]
3. Write a PL/SQL block using SQL and Control Structures in PL/SQL [CO3]
4. Write a PL/SQL Code using Cursors, Exceptions and Composite Data Types [CO3]
5. Write a PL/SQL Code using Procedures, Functions, and Packages FORMS [CO4]
6. Write a PL/SQL Code Creation of forms for any Information System such as Student Information System, Employee Information System etc. [CO4]
7. Demonstration of database connectivity [CO4]

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 create database for user (Creation of Database)
CO2 solve various SQL queries for user defined schemas
CO3 generalize PL/ SQL blocks
CO4 illustrate the usage of user defined packages

II-Year-II Semester	Sensors & Actuators for IoT	L	T	P	C
20CO4C01		0	0	4	2

Course objectives:
The main objectives are
1. Learning theory related to sensors and actuators.
2. Introducing the concept of estimation and measurement.
3. Learn the theory of analog sensors.
4. Learn the theory of digital sensors.
5. Describe the process of controlling actuators.

Unit–1: Introduction (9 hrs)
Role of sensors and actuators, application scenarios, human sensory system, mechatronic engineering, control system architecture, instrumentation process.
Unit–2: Estimation from measurement (10 hrs)
Sensing and estimation, Least squares estimation, maximum likelihood estimation, static and dynamic Kalman filter.
Unit–3: Analog sensors and Transducers (11 hrs)
Sensors and Transducers terminology, types and selection, sensors for electromechanical applications, potentiometer, variable inductance transducers, permanent magnet and eddy current transducers, variable capacitance transducers, piezoelectric sensors, strain gauges, torque sensors, gyroscopic sensors, thermo fluid sensors.
Unit–4: Digital and innovative sensors (9 hrs)
Innovative sensor technology, shaft encoders, incremental optical encoder, motion sensor, data acquisition process, absolute optical encoder, optical sensors, lasers and cameras, miscellaneous sensor technologies, MEMS sensor, wireless sensor networks.
Unit–5: Control strategies of actuators (9 hrs)
Principle of operation, Actuator classification, requirement and applications, control of stepper motors, control of DC motors, control of induction motors, concept, and control of hydraulic actuators
Software's used: CAD, ANSYS, COMSOL, 3D Printing, PLC, Proteus,

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Understanding basics and applications of sensors and actuators.
CO2 Acquire knowledge on various estimation methods.
CO3 Understanding working principles of analog sensors.
CO4 Understanding working principles of digital sensors.

CO5 Outline the control strategies of actuators.

Text books:

1. "Sensors and Actuators Engineering System Instrumentation," Clarence W de Silva, 2016, 2nd edition, CRC press.
2. Sensors, Actuators, and Their Interfaces, Nathan Ida, 2014, Institution of Engineering and Technology
3. Smart Sensors at the IoT Frontier, Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu, 2017, Springer International Publishing

Reference books:

1. Handbook of Modern Sensors, Jacob Fraden, 2004, Springer New York.
2. Sensors and Actuators in Smart Cities, Mohammad Hammoudeh, 2018, Mdpi AG

e-resources:

1. https://nptel.ac.in/courses/108/108/108108147/

III-Year-I Semester	Protocols and Architectures for Wireless Sensor Networks	L	T	P	C
20CO5T01		3	0	0	3

Prerequisite: Data Communications and Networking

Course objectives:
The main objectives are
3. To introduce the concepts and architectures related to wireless sensor networks.
4. To provide insights about the networking aspects, design issues, and service interfaces in WSNs.
5. To understand how the conventional Internet-based MAC protocols are not appropriate for WSNs and demonstrate the design aspects of MAC in WSN environments.
6. To introduce the routing concepts in WSN scenarios
7. To familiarize the need for security in WSNs and elaborate on various security issues with respect to WSNs.

Unit–1: (10 hrs)
Introduction
Brief Historical Survey of Sensor Networks, and Background of Sensor Network Technology, Ad-Hoc Networks, Applications of Wireless Sensor Networks: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Another Taxonomy of WSN Technology, Basic Sensor Network Architectural Elements, Home Control, Medical Applications.
Unit–2: (9 hrs)
Network Architectures in WSN
Sensor network, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.
Unit–3: (9 hrs)
Medium Access Control in WSN
Fundamentals of (wireless) MAC protocols: Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols , MAC protocols for wireless sensor networks, Low duty cycle protocols and wakeup concepts: Sparse topology and energy management (STEM), S-MAC, LEACH, SMACS, Traffic-adaptive medium access protocol (TRAMA).
Unit–4: (10 hrs)
Routing Protocols for WSN
Designing issues, classification of routing protocols, table driven routing

protocols, on demand routing protocol, Hybrid routing protocol, Hierarchical routing protocols. Multicast routing in Ad Hoc wireless networks: Operations and classification of multicast routing protocols, Tree based multicast routing protocol, Mesh based multicast routing protocol.

Unit–5: (10 hrs)

Transport Layer and Security in WSN

Designing issues, classification of transport layer solutions, feedback-based TCP, TCP bus, Ad Hoc TCP, Security in wireless networks, Issues and challenges in security provisioning, Key management, Secure routing in Ad hoc wireless networks. Quality of Service: Issues and challenges in providing QoS in Ad Hoc wireless networks, classification of QoS solutions.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 understand the architectural requirements and application scenarios related to WSNs

CO2 gain the ability to design network scenarios and interfaces for applications related to WSNs

CO3 understand the differences between the conventional MAC protocols and those used in WSNs

CO4 understand the design aspects and basic requirements of the routing protocols in resource-constrained WSNs

CO5 understand the security issues in WSN and gains ability to address the security aspects in the WSNs

Text books:

3. Protocols and architectures for wireless sensor networks, Holger Karl, and Andreas Willig, 2005 John Wiley & Sons.
4. Wireless Sensor Networks – Principles and Practice, 1 edition, Fie Hu, Xiaojun Cao – CRC press

Reference books:

3. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
4. Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons, 2010.

E-Resources:

1. https://nptel.ac.in/courses/106105160
2. https://onlinecourses.swayam2.ac.in/arp19_ap52/preview
3. https://cse.iitkgp.ac.in/~smisra/course/wasn.html

III-Year-I Semester	Machine Learning	L	T	P	C
20CO5T02		3	0	0	3

Prerequisite: Probability and Statistics

Course objectives:
The main objectives are
1. To recognize the importance and characteristics of machine learning.
2. To apply supervised machine learning techniques for data handling and to gain knowledge from it.
3. To apply advanced supervised machine learning and probabilistic models for classification problems.
4. To apply unsupervised machine learning models to real world problems.
5. To evaluate the performance of algorithms and to provide solution for various real-world applications using ensemble models

Unit–1: (10 hrs)
Introduction to Machine Learning
Introduction, Components of Learning, Learning Models, Geometric Models, Probabilistic Models, Logic Models, Grouping and Grading, Designing a Learning System, Types of Learning, Supervised, Unsupervised, Reinforcement, Perspectives and Issues, Version Spaces, PAC Learning, VC Dimension.
Unit–2: (9 hrs)
Supervised Learning
Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.
Unit–3: (9 hrs)
Advanced Supervised Learning
Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors.
Probabilistic Models
Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks.
Unit–4: (10 hrs)
Unsupervised Learning
Introduction to clustering, K-means clustering, K-Mode Clustering, Distance based clustering, Clustering around mediods, Silhouettes, Hierarchical Clustering.

Unit–5: (10 hrs)

Ensemble Learning

Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Recognize the characteristics of machine learning

CO2 Apply various supervised learning methods to appropriate problems

CO3 Identify and integrate more than one technique to enhance the performance of learning and Create probabilistic models for handling unknown pattern

CO4 Apply unsupervised learning models e.g., clustering algorithms to handle the unknown labelled data

CO5 Apply Ensemble models to any real-world problem to Analyze its performance effectively

Text books:

1. EthemAlpaydin,"Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition 2014.
2. MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar "Foundations of Machine Learning," MIT Press, 2012
3. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012

Reference books:

1. Chris Albon : Machine Learning with Python Cookbook , O'Reilly Media, Inc.2018.
2. Tom Mitchell, "Machine Learning," McGraw Hill, 3rd Edition, 1997.
3. Charu C. Aggarwal, "Data Classification Algorithms and Applications," CRC Press, 2014. Stephen Marsland, "Machine Learning – An Algorithmic Perspective," 2nd Edition, CRC Press, 2015.
4. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012 Jiawei Han and MichelineKambers and Jian Pei, "Data Mining –Concepts and Techniques", 3rd Edition,Morgan Kaufman Publications, 2012.
5. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning," Cambridge University Press, 2019.

E- Resources:

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012, https://www.cs.ubc.ca/~murphyk/MLbook/pml-intro-5nov11.pdf.

2. Professor S. Sarkar, IIT Kharagpur "Introduction to machine learning," https://www.youtube.com/playlist?list=PLYihddLFCgYuWNL55Wg8ALkm6u8U7gps.
3. Professor Carl Gustaf Jansson, KTH, Video Course on Machine Learning https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35.
4. Tom Mitchell, "Machine Learning," http://www.cs.cmu.edu/~tom/10701_sp11/lectures.shtml

III-Year-I Semester	Automata Theory and Compiler Design	L	T	P	C
20CO5T03		3	0	0	3

Prerequisite: Mathematical Foundations of Computer Science

Course objectives:

The main objectives are

1. To learn fundamentals of Regular and Context Free Grammars and Languages
2. To understand the relation between Regular Language and Finite Automata and machines
3. To understand the relation between Contexts free Languages, Push Down Automata and Turing Machine
4. To study various phases in the design of compiler and understanding the machine independent phases of compiler
5. To understand machine dependent phases of compiler.

Unit–1: (10 hrs)

Finite Automata

Automata: Need for Automata Theory, Chomsky hierarchy, Acceptance of a string, Design of NFA with ε, NFA without ε, DFA, Equivalence of NFA, DFA

Finite Automata Conversions: Conversion from NFA ε to NFA, NFA to DFA, Minimization of DFA, Moore and Mealy Machines.

Unit–2: (9 hrs)

Regular Expressions and Grammars

Regular Expressions: Regular Sets, Identity Rules, Equivalence of two RE, Manipulations of REs, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE, Pumping Lemma of Regular Sets, Closure Properties of Regular Sets

Grammars: Grammars, Classification of Grammars, Right and Left Linear Regular Grammars, Equivalence between RG and FA, Inter Conversion, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars, Normal Forms- Chomsky Normal Form, Griebach Normal Form.

Unit–3: (9 hrs)

Push Down Automata and Turing Machines

Push Down Automata (PDA): Design of PDA, Deterministic PDA, Non-deterministic PDA, Equivalence of PDA and Context Free Grammars.

Turing Machine (TM): Design of Turing Machine, Deterministic TM, Non-deterministic TM.

Unit–4: (10 hrs)

Machine Independent Phases

Lexical Analysis: Logical phases of compiler**,** Lexical Analysis, Lexemes Tokens and patterns, Lexical Errors, Regular Expressions, Regular definitions for the language constructs, Strings, Sequences, Comments, Transition diagram for recognition of tokens, Reserved words, and identifiers.

Syntax Analysis: Parsing definition, types of parsing, left recursion, left factoring, Top-down parsing, First and Follow, LL(1) Grammars, Non- Recursive predictive parsing, Bottom-up Parsers, Shift Reduce Parsing, LR parsers.

Semantic Analysis: Syntax Directed Translation, L-attributed and S-attributed definitions

Symbol tables: use and need of symbol tables.

Unit–5: (10 hrs)

Machine Dependent Phases

Intermediate Code Generation: Intermediate code, three address code, quadruples, triples, directed acyclic graph.

Code Optimization: Common sub expression elimination, copy propagation, dead code elimination, constant folding, strength reduction, loop optimization.

Code Generation: Basic blocks & flow graphs, Peephole optimization, Register allocation and assignment.

Course Outcomes: Upon successful completion of the course, the student will be able to

- **CO1** Classify machines by their power to recognize languages
- **CO2** Summarize language classes and grammars relationship among them with the help of Chomsky hierarchy
- **CO3** Employ finite state machines in problem solving and also illustrate deterministic and non-deterministic machines
- **CO4** Design and implement scanners and parsers
- **CO5** Perform code optimization to improve performance & apply algorithms to generate code.

Text books:

1. Introduction to Automata Theory, Languages and Computation, J. E. Hopcroft, R. Motwani and J. D. Ullman, 3rd Edition, Pearson, 2008
2. Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra, and N. Chandrasekharan, 3rd Edition, PHI, 2007
3. Compilers, Principles Techniques and Tools- Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D. Ullman,2nd ed, Pearson,2007.

Reference books:

1. Elements of Theory of Computation, Lewis H.P. & Papadimition C.H., Pearson /PHI

2. Theory of Computation, V. Kulkarni, Oxford University Press, 2013
3. Principles of compiler design, V. Raghavan, 2nd ed, TMH, 2011.
4. Compiler construction, Principles and Practice, Kenneth C Louden, CENGAGE

E- Resources & Other Digital Material:

1. https://nptel.ac.in/courses/106/104/106104028/
2. https://nptel.ac.in/courses/106/105/106105190/

University Academy You tube Channel for Automata Theory and Compiler Design:

3. https://www.youtube.com/playlist?list=PL-JvKqQx2AtdhlS7j6jFoEnxmUEEsH9KH
4. https://www.youtube.com/playlist?list=PL-JvKqQx2Ate5DWhppx-MUOtGNA4S3spT

GATE Lectures:

5. https://www.youtube.com/playlist?list=PLEbnTDJUr_IdM___FmDFBJBz0zCsOFxfK
6. https://www.youtube.com/playlist?list=PLMzYNEvC0P7FwwnrXwAjPq8zLTC4MDQK

III-Year-I Semester	Advanced Computer Architecture (Professional Elective-1)	L	T	P	C
PE3101		3	0	0	3

Prerequisite: Computer Organization

Course objectives:

The main objectives are

1. Understand the Concept of Parallel Processing and its applications
2. Implement the Hardware for Arithmetic Operations
3. Analyze the performance of different scalar Computers
4. Develop the Pipelining Concept for a given set of Instructions
5. Distinguish the performance of pipelining and non-pipelining environment in a processor

Unit–1: (10 hrs)

Computer Abstractions and Technology: Introduction, Eight Great Ideas in Computer Architecture, Below Your Program, Under the Covers, Technologies for Building Processors and Memory, Performance, The Power Wall, The Sea Change: The Switch from Uni-processors to Multiprocessors, Benchmarking the Intel Core i7, Fallacies and Pitfalls

Unit–2: (9 hrs)

Instructions: Language of the Computer: Operations of the Computer Hardware, Operands of the Computer Hardware, Signed and Unsigned Numbers, Representing Instructions in the Computer, Logical Operations, Instructions for Making Decisions, Supporting Procedures in Computer Hardware, Communicating with People, MIPS Addressing for 32-Bit Immediate and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, A C Sort Example to Put It All Together, Arrays versus Pointers, ARMv7 (32-bit) Instructions, x86 Instructions, ARMv8 (64-bit) Instructions.

Unit–3: (9 hrs)

Arithmetic for Computers: Introduction, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword Parallelism, Streaming SIMD Extensions and Advanced Vector Extensions in x86, Subword Parallelism and Matrix Multiply.

Unit–4: (10 hrs)

The Processor: Introduction, Logic Design Conventions, building a Datapath, A Simple Implementation Scheme, An Overview of Pipelining, Pipelined Datapath and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions, The ARM Cortex-A8 and Intel Core i7 Pipelines.

Unit–5: (10 hrs)

Large and Fast: Exploiting Memory Hierarchy: Introduction, Memory Technologies, The Basics of Caches, Measuring and Improving Cache Performance, Dependable Memory Hierarchy, Virtual Machines, Virtual Memory, A Common Framework for Memory Hierarchy, Using a Finite-State Machine to Control a Simple Cache, Parallelism and Memory Hierarchies: Cache Coherence, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks, Advanced Material: Implementing Cache Controllers, The ARM Cortex-A8 and Intel Core i7 Memory Hierarchies.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Illustrate the types of computers, and new trends and developments in computer architecture

CO2 Outline pipelining, instruction set architectures, memory addressing

CO3 Apply ILP using dynamic scheduling, multiple issue, and speculation

CO4 Illustrate the various techniques to enhance a processors ability to exploit Instruction-level
parallelism (ILP), and its challenges

CO5 Apply multithreading by using ILP and supporting thread-level parallelism (TLP)

Text books:

1. Computer Organization and Design: The hardware and Software Interface, David A Patterson, John L Hennessy, 5th edition, MK.
2. Computer Architecture and Parallel Processing – Kai Hwang, Faye A.Brigs, Mc Graw Hill.

Reference books:

1. Modern Processor Design: Fundamentals of Super Scalar Processors, John P. Shen, and Miikko H. Lipasti, Mc Graw Hill.
2. Advanced Computer Architecture – A Design Space Approach – Dezso Sima, Terence Fountain, Peter Kacsuk , Pearson.

E-Resources:

1. https://nptel.ac.in/courses/106/105/106105163/

III-Year-I Semester	Social Networks (Professional Elective-1)	L	T	P	C
PE3101		3	0	0	3

Prerequisite: Basic programming concepts

Course objectives:

The main objectives are

1. To train on the concepts and techniques in social networking
2. To emphasize include social networking for business and professional use
3. To comprehend social networking analysis and social network developer tools
4. To apply social network concepts for solving real-world issues

Unit–1: (10 hrs)

Introduction to Python, Introduction to Network, Social Networks: The Challenge, Google Page Rank, Searching in a Network, Link Prediction, The Contagions, Importance of Acquaintances, Marketing on Social Networks

Handling Real-world Network Datasets: Introduction to Datasets, Ingredients Network, Synonymy Network, Web Graph, Social Network Datasets, Datasets: Different Formats, How to Download, Analysing using Network and Analysing using Gephi, Emergence of Connectedness: Introduction, Advanced Material, and Programming Illustration, Summary to Datasets

Strength of Weak Ties: Introduction, Granovetter's Strength of weak ties, Triads, clustering coefficient and neighbourhood overlap, Structure of weak ties, bridges and local bridges, Validation of Granovetter's experiment using cell phone data, Embeddedness, Structural Holesm Social Capital, Finding Communities in a graph (Brute Force Method), Community Detection using Girvan Newman Algorithm, Visualising Communities using Gephi, The Strength, Social Media and Passive Engagement, Between Measures and Graph Partitioning, Strong and Weak Relationship – Summary

Unit–2: (9 hrs)

Homophily: Should you watch your company? Selection and Social Influence, Interplay between Selection and Social Influence, Homophily - Definition and measurement, Foci Closure and Membership Closure, Introduction to Fatman Evolutionary model, Fatman Evolutionary Model- The Base Code (Adding people), The Base Code (Adding Social Foci), Implementing Homophily, Quantifying the Effect of Triadic Closure, Fatman Evolutionary Model- Implementing Closures, Implementing Social Influence, Storing and analyzing longitudinal data

Spatial Segregation: Introduction, Simulation of the Schelling Model – Introduction, Base Code, Visualization and Getting a list of boundary and internal nodes, getting a list of unsatisfied nodes, Shifting the unsatisfied nodes, and visualizing the final graph

Unit–3: (9 hrs)

Hubs and Authorities: PageRank Revisited – An example, convergence in the example, conservation and convergence, Matrix Multiplication, Convergence in Repeated Matrix Multiplication, Addition of Two Vectors, Convergence in Repeated Matrix Multiplication- The Details, PageRank as a Matrix Operation, PageRank Explained

Power law: Introduction, Power Law emerges in WWW graphs, Detecting the Presence of Powerlaw, Rich Get Richer Phenomenon, Implementing Rich-getting-richer Phenomenon, implementing a Random Graph, Forced Versus Random Removal of Nodes

Unit–4: (10 hrs)

Epidemics: Introduction, Simple Branching Process for Modeling Epidemics, Modelling epidemics on complex networks, SIR and SIS spreading models, Comparison between SIR and SIS spreading models, Basic Reproductive Number Revisited for Complex Networks, Percolation model, Analysis of basic reproductive number in branching model, The Generative Model, Decentralized Search

Unit–5: (10 hrs)

Small world networks: Introduction, Base code, making homophily based edges, Adding weak ties, Plotting change in diameter, Myopic Search, Myopic Search comparison to optimal search, Time Taken by Myopic Search, PseudoCores : Introduction, How to be Viral, finding the right key nodes, Coding K-Shell Decomposition, Coding cascading Model

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Demonstrate proficiency and understanding of social networks for business and professional use

CO2 Demonstrate proficiency the use of social network analysis and social network developer tools

CO3 Demonstrate proficiency and understanding of public sector media and privacy

CO4 Demonstrate proficiency in understanding concepts in social networking and utilizing these concepts or solving real-world social network issues

Text books:

1. Social Networks, Prof. Sudharshan Iyengar, Computer Science and Engineering, IIT Ropar
2. Perspectives on Social Media: A Yearbook. Piet A.M. Kommers, Pedro

Isaias, and Tomayess Issa

Reference books:

1. M. L. Davison. Multidimensional scaling. (John Wiley and Sons, 1983).
2. S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications (Cambridge, Cambridge University Press, 1994), Chapters 7 and 9.

E-Resources:

1. https://nptel.ac.in/courses/106106169

III-Year-I Semester	Software Engineering (Professional Elective-1)	L	T	P	C
PE3101		3	0	0	3

Prerequisite: Basic software knowledge

Course objectives:
The main objectives are
1. To understand the software life cycle models.
2. To understand the software requirements and SRS document.
3. To understand the importance of modelling and modelling languages.
4. To design and develop correct and robust software products.
5. To understand the quality control and how to ensure good quality software.

Unit–1: (10 hrs)
Introduction to Software Engineering:
Software, Software Classifications and Characteristics, Emergency of Software Engineering, what is Software Engineering? Software Engineering Challenges
Software Processes Process model, Elements and Characteristics of Process model, Process Classification, Phased Development Life Cycle, Software Development
Process Models: Prescriptive Process Models, Agile process models, and RUP process model
Unit–2: (9 hrs)
Project Management & Planning:
Project management essentials, Project success and failures, Project Life Cycle, Project team structure and organization, Software Configuration Management. Project planning activities, Metrics and Measurements, Project Size Estimation, Effort Estimation Techniques, Staffing and Personnel Planning, Project Scheduling and Miscellaneous Plans.
Unit–3: (9 hrs)
Requirement Engineering:
Software Requirements, Requirement Engineering Process, Requirement Elicitation, Requirement Analysis (Structured Analysis, Object Oriented Analysis, Data Oriented Analysis and Prototyping Analysis), Requirements Specification, Requirement Validation, and Requirement Management.
Unit–4: (10 hrs)
Software Design:
Software Design Process, Characteristics of a Good Design**,** Design Principles, Modular Design (Coupling and Cohesion), Software Architecture, Design Methodologies (Function Oriented Design and Object-Oriented Design), Structured Design Methodology (SDM), Transaction Analysis and Logical

Design;
Coding: Coding principles, Coding process, Code verification and documentations.
Unit–5: (10 hrs)
Software Testing
Testing Fundamentals, Test Planning, Black Box Testing, White Box Testing, Levels of Testing, Debugging Approaches
Quality of Software: Quality Concept, Quality Factors, Verification and Validation, Quality Assurance Activities, Quality Standards: Capability Maturity Model (CMM), ISO 9000, Six Sigma.
Maintenance: Software Maintenance, Maintenance Process Models and Reengineering.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Define and develop a s/w project from requirement gathering to implementation
CO2 Obtain knowledge about principles and practices of software engineering
CO3 Focus on the fundamentals of modelling a software project
CO4 Obtain knowledge about estimation and maintenance of software systems
CO5 Design test cases, schedules and perform testing for SQA

Text books:

1. Software Engineering: Concepts and Practices- UgrasenSuman, Cengage Learning Publications.
2. Fundamentals of Software Engineering-Rajib Mall, PHI, New Delhi.

Reference books:

1. An Integrated Approach to S/w Engineering- PankajJalote, Narosa Publishing House.
2. Software Engineering- Ian Sommerville, Pearson Education, New Delhi.
3. Software Engineering Concepts-Richard E. Fairly, Tata McGraw Hill Inc. New York.

E-Resources:

1. https://nptel.ac.in/courses/106105182

III-Year-I Semester	Computer Graphics (Professional Elective-1)	L	T	P	C
PE3101		3	0	0	3

Prerequisites: Familiarity with the theory and use of coordinate geometry and of linear algebra such as matrix multiplication, Computer Programming and Data Structures.

Course objectives:

The main objectives are

1. To develop, design and implement two- and three-dimensional graphical structures
2. To enable students to acquire knowledge Multimedia compression and animations.
3. To learn Creation, Management and Transmission of Multimedia objects

Unit–1: (10 hrs)

Introduction to Computer Graphics : Applications of Computer Graphics, 2D Primitives:- Output Primitives: Points, Lines, Planes, Frame-Buffers, Video-display devices, Line Drawing Algorithms: DDA Line drawing, Bresenham's Line Drawing, Parallel Line Drawing ,Circle and Ellipse Generation, Polygon Generation, Polygon Filling Algorithms, Attributes of Output Primitives.

Unit–2: (9 hrs)

2D Transformations & Viewing: Basic Transformations: Translation, Rotation, Scaling, Other Transformations: Reflection, Shear, Composite Transformations, Coordinate Transformation, Viewing Pipeline: Viewing Reference Frame, window, view-port, window-to- view-port Transformation, Multiple window transformation, Clipping: Line Clipping: cohen- sutherland line clipping algorithm, Polygon Clipping: Sutherland-Hodheman polygon clipping algorithm, Text Clipping. .

Unit–3: (9 hrs)

3D Concepts: 3D Object Representation: Polygons, Curved Lines, Splines, Quadric Surfaces, 3D Transformations : Basic :Translation, Coordinate-axis-Rotation, Arbitrary-axis Rotation, Scaling, Other: Reflection, Shear, Composition of 3D transformations, ,Projections : Parallel, Perspective, 3D Viewing, Visible-Surface Detection Algorithms: Back face removal, Z-Buffer, A-Buffer, Area-sub-division, Depth-Sorting(painter's),BSP-Tree,Octree,3D Clipping

Unit–4: (10 hrs)

Graphics Programming Color Models – RGB, YIQ, CMY, HSV – Animations – General Computer Animation, Raster, Keyframe

Graphics programming using OPENGL – Basic graphics primitives –Drawing three dimensional objects - Drawing three dimensional scenes

Rendering Introduction to Shading models – Flat and Smooth shading – Adding texture to faces – Adding shadows of objects – Building a camera in a program – Creating shaded objects– Rendering texture – Drawing Shadows

Unit–5: (10 hrs)

Fractals and Self similarity – Peano curves – Creating image by iterated functions – Mandelbrot sets – Julia Sets – Random Fractals.

Overview of Ray Tracing Intersecting rays with other primitives – Adding Surface texture – Reflections and Transparency – Boolean operations on Objects.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand Applications, video devices and analyze 2D Objects by learning output primitives

CO2 Analyze various 2D Object representation models by learning various visualization techniques

CO3 Analyze various 3D Object representation models by learning various visualization techniques

CO4 Develop programs in OPENGL by using apt functions for efficacy in Computer Graphics 2D/3D and Animation.
Perform Rendering of 2D/3D Objects by learning about shading, texture mapping techniques and drawing shadows

CO5 Design complicated Real-World Scenes by learning Iterated Function Systems for implementing Fractals
Apply 3D Solid Geometric Techniques for representing 3D objects

Text books:

1. Donald Hearn, Pauline Baker, Computer Graphics – C Version, second edition Pearson Education,2004.
2. F.S. Hill, Computer Graphics using OPENGL, Second edition, Pearson Education, 2003.

Reference books:

1. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics- Principles and practice, Second Edition in C, Pearson Education, 2007.
2. Procedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
3. Principles of Interactive Computer Graphics," Neuman and Sproul, TMH.
4. Principles of Computer Graphics, Shalini Govil, Pai, 2005, Springer.

E-Resources:

1. https://nptel.ac.in/courses/106106090

III-Year-I Semester	Design and Analysis of Algorithms (Professional Elective-1)	L	T	P	C
20CO5P05		3	0	0	3

Prerequisite: Computer programming and Data Structures.

Course objectives:
The main objectives are
1. To provide an introduction to formalisms to understand, analyse and denote time complexities of algorithms
2. To introduce the different algorithmic approaches for problem solving through numerous example problems
3. To provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness

Unit–1: (10 hrs)
Introduction: Algorithm Definition, Algorithm Specification, Performance Analysis, Performance Measurement, Asymptotic notations.
Divide and Conquer: General Method, Binary Search, Finding the Maximum and Minimum, Quick Sort.
Unit–2: (9 hrs)
The Greedy Method: The General Method, Knapsack Problem, Single Source Shortest Path Problem, Optimal Storage on Tapes Problem, Optimal Merge Patterns Problem.
Unit–3: (9 hrs)
Dynamic Programming: The General Method, 0/1 Knapsack Problem, Single Source Shortest Path – General Weights, All Pairs-Shortest Paths Problem, Traveling Salesperson Problem, String Editing Problem
Unit–4: (10 hrs)
Backtracking: The General Method, The N-Queens Problem, Sum of Subsets Problem, Graph Colouring Problem, Hamiltonian Cycles Problem.
Unit–5: (10 hrs)
Branch and Bound: The General Method, FIFO Branch-and-Bound, LC Branch-and-Bound, 0/1 Knapsack Problem, Travelling Salesperson Problem.
NP-Hard and NP-Complete problems: Basic concepts, Cook's Theorem.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Infer the divide-and-conquer paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems. Derive and solve recurrences describing the performance of divide-and-conquer algorithms

CO2 Infer the greedy paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems

CO3 Infer the dynamic-programming paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems

CO4 Infer the backtracking paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems

CO5 Infer the branch and bound paradigm and its context. Recite algorithms that employ this paradigm. Apply this paradigm to design algorithms for apt problems

Text books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms," 2nd Edition, Universities Press.

Reference books:

1. Harsh Bhasin, "Algorithms Design & Analysis," Oxford University Press.
2. S. Sridhar, "Design and Analysis of Algorithms," Oxford University Press.

Web Resources:

1. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
2. https://www.javatpoint.com/daa-tutorial
3. https://nptel.ac.in/courses/106106131
4. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm

III-Year-I Semester	Microprocessors and Microcontrollers for IoT (Open Elective-1)	L	T	P	C
20EC5O02		3	0	0	3

Prerequisite: Basics of electronics, DLD, Computer Organization

Course objectives:
The main objectives are

1. To acquire knowledge about microprocessors, and study the Architectures of 8-bit and 16-bit Microprocessors with assembly language programming skills.
2. To acquire the knowledge on interrupts, interfacing with various peripherals configure and develop programs to interfacing peripherals.
3. To differentiate the architectural advancements in the Intel microprocessors
4. To understand the fundamental concepts of 8051 Microcontroller and its architecture.
5. To study the concepts of PIC and ARM processors and their architecture

Unit–1: (10 hrs)
8085/8085 Microprocessor: 8085: Features and Architecture, 8086 Architecture: Bus Interfacing Unit, Memory Segmentation and Physical Address Computations, Execution Unit, Register Organization of 8086, Pin Diagrams, Signal Descriptions, Minimum and Maximum Mode of 8086 System Introduction to Stack, Stack Structure of 8086, 8086 Programming: Addressing modes of 8086, Assembler Directives, Introduction to TASM, 8086 instructions: Data Transfer Instructions, Arithmetic Instructions, Logical Instructions, Bit Manipulation Instructions, Program Execution Transfer Instructions (Branch & Loop Instructions), Processor Control Instructions, Simple programs on 8086, Difference Between 8085 and 8086.

Unit–2: (9 hrs)
8086 Interfacing: Memory Interfacing: Semiconductor memories (RAM, ROM), I/O Interfacing: Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Intel 8251 USART: architecture and concept

Unit–3: (9 hrs)
Advanced INTEL Microprocessors: Introduction to 80286, 80386 and 80486, special purpose registers, memory organization, moving to protected mode, virtual mode, memory paging mechanism, architectural differences between 80386 and 80486 microprocessors. Introduction to Pentium and Pentium Pro microprocessors.

Unit–4: (10 hrs)
Intel 8051 Microcontroller: 8051 Architecture: Architecture, Input/output

ports, Register organization, memory organization, counters/timers, serial data input/output, interrupts. Assembly language programming: Instructions, addressing modes, simple programs. Interfacing to 8051: A/D and D/A Convertors, Stepper motor interface, LCD Interfacing, Keyboard Interfacing.

Unit–5: (10 hrs)

ARM Architectures and Processors: ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, Programming Model.

PIC Microcontroller: Introduction, characteristics of PIC microcontroller, PIC microcontroller families, PIC 16F877: Registers and memory organization, architecture, Programming Model.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the architecture of microprocessor and their basic hardware components and programming methods.

CO2 Design processor-based systems using various interfacing techniques

CO3 Contrast the advanced microprocessors in terms of architectural aspects

CO4 Understand the architecture of 8051 microcontroller, it's operation and interfacing

CO5 Able to illustrate architectural differences of ARM Cortex processors and PIC microcontrollers

Text books:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition,1994.
2. A.K.Ray and K.M. Bhurchandi, "Advanced Microprocessor and Peripherals" Tata McGraw Hill, 3rd Edition, 2013
3. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2-Edition, 2011.
4. Microcontroller: Theory and Applications, Ajay V Deshmukh, The McGraw Hill, 1st Edition, 2005.
5. The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by JosephYou.

Reference books:

1. Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English, by Dr. Alexander G. Dean, Published by Arm Education Media,2017.
2. Cortex -M3 Technical Reference Manual

E-Resources:

1. https://nptel.ac.in/courses/106/108/106108100/
2. https://nptel.ac.in/courses/117/104/117104072/#
3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ee42/
4. https://nptel.ac.in/courses/108/107/108107029/

III-Year-I Semester	Data Warehousing and Data Mining (Open Elective-1)	L	T	P	C
OE3101		3	0	0	3

Prerequisite: Database Management Systems, Probability and Statistics

Course objectives:

The main objectives are

1. To understand basic concepts, architectures, and classical models in data warehousing
2. To understand data mining concepts and pre-processing techniques
3. To master in association analysis techniques in various applications like social, scientific, and environmental context.
4. To develop skill in selecting the appropriate classification algorithm for solving practical problems
5. To characterize the kinds of patterns that can be discovered by clustering

Unit–1: (10 hrs)

Introduction to Data Warehousing: Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Data warehouse Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP.

Unit–2: (9 hrs)

Introduction to Data Mining: Introduction, Definition, KDD, Challenges, Data Mining Functionalities. Data Objects and Attribute Types, Measuring Data Similarity and Dissimilarity, **Data Pre-processing**: Introduction, Data Pre-processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

Unit–3: (9 hrs)

Association Analysis: Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithm, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set.

Unit–4: (10 hrs)

Classification: Problem definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision trees: Decision Tree Construction, Methods for expressing attribute test conditions, Measures for Selecting the Best split, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification-Algorithm and characteristics.

Unit–5: (10 hrs)

Clustering: Problem Definition, Clustering overview, Evaluation of clustering algorithms, Partitioning clustering K-Means Algorithm, K-Means Additional Issues, PAM Algorithm, Hierarchical Clustering-Algorithm- Agglomerative Methods and Divisive Methods, Basic Agglomerative Hierarchical Clustering Algorithm, DBSCAN Algorithm, Strengths, and Weaknesses.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand basic concepts, architectures, and classical models in data Warehousing

CO2 Understand data mining concepts and pre-processing techniques

CO3 Master in association analysis techniques in various applications like social, scientific, and environmental context

CO4 Develop skill in selecting the appropriate classification algorithm for solving practical problems

CO5 Characterize the kinds of patterns that can be discovered by clustering

Text books:

1. Han, Kamber, "Data Mining Concepts and Techniques", 3rd Edition
2. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Miming," Pearson Education.

Reference books:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Data Ware Housing Fundamentals, Pualraj Ponnaiah, Wiley Student Edition.
3. The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley Student Edition.
4. Data Mining, Vikaram Pudi, P Radha Krishna, Oxford University.

III-Year-I Semester	Green Buildings (Open Elective-1)	L	T	P	C
OE3101		3	0	0	3

Course objectives:
The main objectives are
1. Learn the principles of planning and orientation of buildings.
2. Acquire knowledge on various aspects of green buildings

Unit–1: (10 hrs)
Green Buildings within the Indian Context, Types of Energy, Energy Efficiency and Pollution, Better Buildings, Reducing energy consumption, Low energy design.
Unit–2: (9 hrs)
Renewable Energy sources that can be used in Green Buildings – Conventional and Non-Conventional Energy, Solar energy, Passive Solar Heating, Passive Solar collection, Wind, and other renewables. A passive solar strategy, Photovoltaics, Rainwater Harvesting Climate and Energy, Macro and Microclimate. Indian Examples.
Unit–3: (9 hrs)
Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, rouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material.
Unit–4: (10 hrs)
Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modelling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, new light sources. Cooling buildings, passive cooling, mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection, and utilization of rain water.
Unit–5: (10 hrs)
Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g., LEED, GRIHA & IGBC Certification for buildings. Ecohomes, Sustainable architecture and urban design – principles of environmental architecture, Benefits of green buildings – Energy Conservation Building code - NBC -Case Studies – Green Buildings in Auroville and Dakshina Chitra, Tamil Nadu, India

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Explain the principles of building planning, its bylaws and provide facilities for rainwater harvesting

CO2 Understand the concepts of green buildings

Text books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tomwoolley and Samkimings, 2009.

Reference books:

1. Complete Guide to Green Buildings by Trish riley
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

E-Resources:

1. https://nptel.ac.in/courses/105102195

III-Year-I Semester	Optimization Techniques (Open Elective-1)	L	T	P	C
OE3101		3	0	0	3

Course objectives:
The main objectives are

1. To understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.
2. To formulate real-life problems with Linear Programming models using graphical and simplex methods.
3. To formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks.
4. To apply dynamic programming and integer programming to optimize multi stage decision problems.
5. To determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation.

Unit–1: (10 hrs)
Introduction to Classical Optimization Techniques
Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.
Classical Optimization Techniques
Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions
Unit–2: (9 hrs)
Linear Programming
Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem.
Simplex Method –
Phase I of the Simplex Method, Primal and Dual Simplex Method, Big –M method.
Unit–3: (9 hrs)
Transportation Problem
Finding initial basic feasible solution by north – west corner rule, least cost method, and Vogel's approximation method – testing for optimality of balanced transportation problems.

Network Analysis

Introduction, Project scheduling by CPM and PERT, Network diagram representations, Rules to construct Network diagrams, Time estimates in network analysis-EST, EFT, LST, LFT, float/slack and critical path, Time estimates and Probability considerations in PERT, Crashing in PERT

Unit–4: (10 hrs)

Dynamic Programming

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Integer Programming

Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.

Unit–5: (10 hrs)

Game theory:

Theory Of Games: Introduction – Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, m X 2 & 2 X n games, Graphical method.

Simulation Modelling

Introduction, Definition and types, Limitations, Various phases of modelling, Monte Carlo method, Applications, advantages, and limitations of simulation

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function

CO2 formulate real-life problems with Linear Programming models using graphical and simplex methods

CO3 formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms and to find out probability of expected completion time using PERT-CPM networks

CO4 apply dynamic programming and integer programming to optimize multi stage decision problems

CO5 determine the level of game theory and simulation modelling that a business must maintain to ensure smooth operation

Text books:

1. Engineering optimization: Theory and practice by S.S.Rao, New Age

International (P) Limited.
2. Operations Research: An Introduction by H A Taha, 5th Edition, Macmillan, New York.
3. Operations Research by P K GUPTA AND D S HIRA BY SCHAND PUBLICATIONS, 7E

Reference books:

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C. Mohan, New Age, International (P) Limited, Publishers
2. Operations Research – by S.D.Sharma, Kedarnath Ramanath& Co
3. Linear programming, G. Hadley, Narosa Publishing House, New Delhi.
4. Industrial Engineering and Production Management, M. Mahajan, Dhanpat Rai & Co.

E-Resources:

1. http://www.aicte-india.org/flipbook/p%26ap/Vol.%20II%20UG/UG_2.html#p%3D8
2. http://www.britannica.com/topic/operations-research

III-Year-I Semester	Protocols and Architectures for Wireless Sensor Networks Lab	L	T	P	C
20CO5L01		0	0	3	1.5

Course objectives:
The main objectives are
1. To introduce MATLAB software tool for simulating WSN environment.
2. To design and evaluate the performance of the medium access control (MAC) protocols in the resource-constrained WSN networks.
3. To design and evaluate the performance of various clustering and routing protocols WSN networks.
4. To study the impact of energy efficiency in WSN for efficient packet delivery and longer network life time

List of Experiments
1. Implement a Non-persistent medium access control in a Wireless Sensor Network environment and demonstrate the access control process.
2. Implement a p-persistent medium access control in a Wireless Sensor Network environment and demonstrate the access control process.
3. Implement a slotted-ALOHA medium access control in a Wireless Sensor Network environment and demonstrate the access control process.
4. Demonstrate the operation of S-MAC protocol in a WSN radio environment.
5. Implement the LEACH-based clustering protocol in a WSN radio environment.
6. Demonstrate the energy efficiency of HEED in WSN scenario.
7. Demonstrate the energy efficiency of VEEC in WSN scenario.
8. Demonstrate the energy efficiency of DEEC in WSN scenario.
9. Simulate the performance of SEP routing protocol and demonstrate its applicability in a WSN.
10. Simulate the performance of Z-SEP routing protocol and demonstrate its applicability in a WSN.
11. Evaluate the performance of various routing protocols in terms of
    (a) Throughput
    (b) Network Life Time
    (c) Packet Delivery Rate

List of Additional Experiments
1. Implementation of AODV (Ad hoc On-demand Distance Vector) routing protocol.
2. Implementing RPL (Routing protocol for Low-Power and Lossy Networks) protocol in a WSN environment.
3. Implementation of CoAP protocol in WSN scenario.

LABORATORY REQUIREMENTS

- A PC with high-end processor and a minimum of 4 GB RAM
- Windows 10
- MATLAB Software (R14 or Higher version)

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the use of MATLAB software tool for simulating WSN environment

CO2 Design and evaluate the performance of the medium access control (MAC) protocols in the resource-constrained WSN networks

CO3 Design and evaluate the performance of various clustering and routing protocols WSN networks

CO4 Understand the need for energy efficiency in resource-limited WSN for better packet delivery and longer network life time

III-Year-I Semester	Machine Learning Lab	L	T	P	C
20CO5L02		0	0	3	1.5

Course objectives:

The main objectives are

1. Understand various ML problem solving techniques
2. Understand various machine learning techniques
3. To work with machine learning tools

List of Programs

1. Write a python program to import and export data using Pandas library functions.
2. Demonstrate various data preprocessing techniques for a given dataset.
3. Implement Dimensionality reduction using Principle Component Analysis (PCA) method.
4. Write a Python program to demonstrate various Data Visualization Techniques.
5. Implement Simple and Multiple Linear Regression Models.
6. Develop Logistic Regression Model for a given dataset.
7. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
8. Implement Naïve Bayes Classification in Python
9. Build KNN Classification model for a given dataset.
10. Build Artificial Neural Network model with back propagation on a given dataset.
11. a) Implement Random Forest ensemble method on a given dataset.
    b) Implement Boosting ensemble method on a given dataset.
12. Write a python program to implement K-Means clustering Algorithm.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Applying the problem-solving techniques of ML

CO2 Understand and implement the procedures for machine learning algorithms

CO3 Design Python programs for various machine learning algorithms

CO4 Apply appropriate datasets to the Machine Learning algorithms

CO5 Analyze the graphical outcomes of learning algorithms with specific datasets

III-Year-I Semester	.NET Eco Systems	L	T	P	C
20CO5E01		0	0	4	2

Course objectives:
The main objectives are
1. Introduce to .Net IDE Component Framework
2. Programming concepts in .Net Framework
3. Creating website using C# and ASP.Net Controls

Unit–1: (10 hrs)
Introduction to .NET Technology
Introduction: Introduction to .NET Framework, Visual Studio, Features of .NET, .NET Framework Architecture.
Unit–2: (9 hrs)
Introduction to C#.NET
Introduction to C#.NET, OOPS in C#.NET, IDE OF Forms, Assemblies, and Namespaces, Streams, Multithreading.
Unit–3: (9 hrs)
Introduction to ASP.NET and Programming
Introduction to ASP.NET and Programming, Web Form Fundamentals, Web Controls, State Management, Tracing, Session tracking, Fundamentals of ASP.net core.
Unit–4: (10 hrs)
Introduction to ADO.NET Fundamentals
ADO.NET Fundamentals, Data Binding-Single valued, Multi valued, The Data Controls-Form View, Grid View.
Unit–5: (10 hrs)
Introduction to LINQ and Entity Framework.
LINQ and the Entity Framework, working with Services, Putting ASP.NET MVC in Context, Your First MVC Application.

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Create user interactive web pages using C# and ASP.Net.
CO2 Create simple data binding applications using ADO.Net connectivity.
CO3 Performing Database operations for Windows Form and web applications.

Text books:
1. “Beginning ASP.NET 4.5 in C#,” Matthew MacDonald, Apress Publishing Company
2. “Professional ASP.NET 4.5 in C# and VB,” Jason N. Gaylord, Christian

Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, John Wiley & Sons, Inc., Indianapolis, Indiana
3. “Pro ASP.NET MVC 5”, Adam Freeman, Apress Publishing Company.

Reference books:

1. “Microsoft Windows Communication Foundation Step by Step,” john sharp, Microsoft Press.
2. “C# 3.0 UNLEASHED with the .net framework 3.5,” second edition, Joe Mayo.

E-Resources:

1. https://www.c-sharpcorner.com/blogs/what-is-net-technology
2. https://www.geeksforgeeks.org/introduction-to-c-sharp/
3. https://www.javatpoint.com/asp-net-introduction
4. https://www.youtube.com/watch?v=aoFDyt8oG0k&list=PL6n9fhu94yhX5dzHunAI2t4kE0kOuv4D7
5. https://www.c-sharpcorner.com/article/introduction-to-linq-with-entity-framework-in-visual-studio2/

III-Year-I Semester	Constitution of India	L	T	P	C
20SH5N02		2	0	0	0

Course objectives:
The main objectives are

1. To Enable the student to understand the importance of constitution
2. To understand the structure of executive, legislature, and judiciary
3. To understand philosophy of fundamental rights and duties
4. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
5. To understand the central and state relation financial and administrative

Unit–1: (10 hrs)
Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy
Unit–2: (9 hrs)
Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;
Unit–3: (9 hrs)
State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.
Unit–4: (10 hrs)
Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Panchayats: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy.
Unit–5: (10 hrs)
Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissioner ate State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Know the sources, features, and principles of Indian Constitution.
CO2 Learn about Union Government, State government and its administration.
CO3 Get acquainted with Local administration and Pachayati Raj.
CO4 Be aware of basic concepts and developments of Human Rights.
CO5 Gain knowledge on roles and functioning of Election Commission

Text books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. New Delhi
2. Subash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-Resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

III-Year-II Semester	Engineering Economics and Management	L	T	P	C
20SH6T02		3	0	0	3

Course objectives:

The main objectives are

1. To understand the concept and nature of Economics and Demand. And to familiarize about the Production function, Input Output relationship, Cost-Output relationship, and Break-Even Analysis.
2. To understand the nature of markets and the concepts of Money and RBI functions.
3. To familiarize with the process of management, principles, and to provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
4. To learn different Accounting Systems, preparation of Financial Statement and to familiarize with the tools of project Management.
5. To understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit–1: (13 hrs)

Introduction to Economics and Theory of Production

Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics –Concept of Demand, Types of Demand, Determinants of Demand-Law of Demand -Elasticity of Demand, Types of Elasticity of Demand.

Theory of production; production function, Law of variable proportions & law of returns to scale, Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, simple problems.

Unit–2: (9 hrs)

Introduction to Markets and Money

Markets: meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly).National Income, GNP, GDP, NNP, NDP, Personal income and GST (Goods & Service Tax).

Money: meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools, Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR.

Unit–3: (9 hrs)

Introduction to Management

Concept –nature and importance of Management Functions of Management, Principles of Management.

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.
Marketing Management: Functions of Marketing - Marketing strategies based on product Life Cycle, Channels of distributions.

Unit–4: (10 hrs)

Introduction to Accounting & Project Management

Introduction to Double Entry System, Journal, Ledger, Trail Balance, and Preparation of Final Accounts with adjustments – Preparation of Financial Statements.
Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path (Simple Problems).

Unit–5: (10 hrs)

Capital and Capital Budgeting

Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method, and Profitability Index).

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Equip with the knowledge of estimating the Demand and demand elasticities for a product and Input-Output-Cost relationships.

CO2 Understand the nature of different markets and also to have the knowledge of Money & Banking.

CO3 Acquire the knowledge on management, HRM and Marketing.

CO4 Acquire the knowledge to prepare Financial Statements and the techniques of project management.

CO5 Evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

Text books:

1. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2018,2e.
2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis,' Cengage Publications, New Delhi – 2012.
3. Management Science, Aryasri, Tata McGraw Hill, 2014.
4. Dr. P. Vijaya Kumar & Dr. N. Appa Rao, 'Introduction to Management Science' Cengage, Delhi, 2012.
5. Engineering Economy and Management 1 Edition Pravin Kumar – Wiley

Publication.
6. Engineering Economics & Management- Dr. Vilas Kulkarni & HardikBavishi - Vikas Publishing.

Reference books:

1. R. L Varshney, K.L. Maheshwari: Managerial Economics, Sultan Chand & Sons 2014, 22e.
2. Suma Damodaran : Managerial Economics, Oxford 2010,2e.
3. Ambrish Gupta: 'Financial Accounting for Management,' Pearson 2015, 5e.
4. Dr. S.N. Maheswari: Financial Accounting, Vikas Publications 2018.
5. S. A. Siddiqui & A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2017.
6. Principles of Marketing: A South Asian Perspective, Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshan ul Haque , 17th Edition, Pearson Education/ Prentice Hall of India, 2018.
7. Human Resource Management: Gary Dessler, 14th Edition, pearson 2015.
8. Project Planning and Control with PERT and CPM: Dr. B. C. Punmia, K. K Khandelwal, Laxmi Publication, 2017, 4th Edition.

E-Resources:

1. www.managementstudyguide.com
2. www.tutorialspoint.com
3. www.lecturenotes.in

III-Year-II Semester	Embedded Real Time Operating Systems	L	T	P	C
20CO6T01		3	0	0	3

Course objectives:

The main objectives are

1. To introduce the basic concepts of embedded systems, their characteristics, and applications.
2. To introduce the design concepts of embedded firmware and interrupt servicing mechanisms.
3. To introduce various development and testing tools related to embedded system development.
4. Introduce the fundamental design concepts of real-time systems and the need for RTOS.
5. To provide greater understanding of the real-time scenarios by exploring broad spectrum of applications

Unit–1: (10 hrs)

Introduction

Embedded system-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

Unit–2: (9 hrs)

Embedded Firmware Design

Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler

Unit–3: (9 hrs)

Embedded System Development

The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware, ICE.

Unit–4: (10 hrs)

Real-Time Operating Systems

Real-time operating Systems – Characteristics, differentiation between GPOS and RTOS, basic design issues using RTOS, RTOS scheduling models, interrupt latency, response time, operating system security issues

Unit–5: (10 hrs)

Real-Time Operating Systems Programming

Basic functions of RTOS, Types of RTOS: μCOS-II, VxWorks, Case Studies: Embedded systems design for automatic chocolate vending machine, Digital Camera Hardware and Software, Adaptive Cruise Control (ACC) system for a car, smart cards

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the basic concepts of embedded systems, their characteristics, and applications

CO2 Analyze the design issues related to embedded firmware and interrupt servicing mechanisms

CO3 Get familiarized with various development and testing tools related to embedded systems

CO4 Understand the fundamental design concepts of real-time systems and the need for RTOS

CO5 Explore the areas where real-time systems can be deployed to enhance the existing solutions

Text books:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.
3. Embedded Systems – Architecture, Programming and Design - Raj Kamal 2nd Edition, Tata McGraw Hill Education Private Limited, 2008.

Reference books:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems-Lyla B.Das-Pearson Publications, 2013.

E-Resources:

1. https://nptel.ac.in/courses/106105172

III-Year-II Semester	Mobile Application Development for IoT	L	T	P	C
20CO6T02		3	0	0	3

Course objectives:

The main objectives are

1. To introduce mobile design principles and implementation of the Application development with Android and IOS.
2. To develop competency in the students to independently design and develop own professional apps

Unit–1: (10 hrs)

A brief history of mobile-Mobile ecosystem, Mobile Information Architecture, Mobile Design, Types of mobile application, Brief discussion on Java Programming, API levels, API-Components Basics: Activities, Services, Broadcast Receivers, Content Providers

Unit–2: (9 hrs)

HTML, java scripting and Jquery for mobile application development, Tools for App development, creating your first project- Layouts, Views and Resources, Text and Scrolling Views, Activity Lifecycle and Saving State.

Unit–3: (9 hrs)

Activities and Implicit Intents, User Input Controls Menus, Selection components (Grid View, List View, Spinner), Adapters, Custom Adapters, Complex UI components, Creating custom and compound Views. Notifications-Toast, Dialogs, Status bar Notifications.

Unit–4: (10 hrs)

Drawables, Themes and Styles, Material design, providing resources for adaptive layouts, Testing the user interface, Background processes.

Unit–5: (10 hrs)

Android-Shared Preferences, Android File System- Internal storage, External storage, SQLite, local Storage and session Storage, Client-Side Database PhoneGap tool, Publishing App.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Use development tools for the Android/IOS app development

CO2 Use of the major components of Android API

CO3 Summarize new UI components and widgets

CO4 Store and manipulate data with apps

CO5 Package and prepare their apps for distribution on the Play Store

Text books:

1. Paul Deitel,Harvey Deitel, Abbey Deitel,Michael “Android for programmers an app-driven approach developer series,” Morgano-2013 Pearson Education, Inc.

Reference books:

1. John Horton, ”Android Programming for beginners,” PACKT Publishing,2015

E-Resources:

1. https://developer.android.com/studio/write/java8-support?gclid=Cj0KCQjw2MWVBhCQARIsAIjbwoPPZ5iQzaqNNV26h5NDA8rGl_tOtH5e5FbkleVtnxkoHtB1HzbKKx8aAgUhEALw_wcB&gclsrc=aw.ds

III-Year-II Semester	Advanced Java Programming	L	T	P	C
20CO6P01		3	0	0	3

Course objectives:

The main objectives are

1. To impart the knowledge on collection framework.
2. To make the students to develop network-based applications.
3. To introduce XML and processing of XML Data with Java.
4. To introduce Server-side programming with Java Servlets and JSP

Unit–1: (10 hrs)

The Collections Framework (java.util)- Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Accessing a Collection via an Iterator, Using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes, and Interfaces- Dictionary, Hash table, Properties, Stack, Vector.

Unit–2: (9 hrs)

Introduction to Networking: Basics of Networking, Networking classes and Interfaces, Networking with URLs, exploring java.net package.

JDBC Connectivity: JDBC connectivity, types of Jdbc Drivers, connecting to the database, JDBC Statements, JDBC Exceptions, Manipulations on the database

Unit–3: (9 hrs)

HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets;

XML: Introduction to XML, Defining XML tags, their attributes and values, Document Type Definition, XML Schemas, Document Object Model, and Extensible Style sheet Language and XSL Transformations, Parsing XML Data – DOM and SAX Parsers in java.

Unit–4: (10 hrs)

Introduction to Servlets: Life cycle of a Servlet, deploying a servlet, The Servlet API, Reading Servlet parameters, Reading Initialization parameters, Handling Http Request & Responses, Using Cookies and Sessions

Unit–5: (10 hrs)

Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session for session tracking.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Use various data structures using java collections
CO2 Understand the trade-offs of implementation of priority queues
CO3 Implement web-based applications using features of HTML and XML
CO4 Appreciate the importance and significance of graph algorithms in building and solving real world applications
CO5 Understand and implement algorithms for pattern matching in a text

Text books:

1. Java The Complete Reference, Herbert Schildt, MC GRAW HILL Education, 9 th Edition, 2016
2. Internet and World Wide Web – How to program, Dietel and Nieto, Pearson.
3. Java Server Pages –Hans Bergsten, SPD O'Reilly.

Reference books:

1. Chris Bates, "Web Programming, building internet applications," 2ndEdition, WILEY,
   Dreamtech, 2008.
2. Thomas A Powel, "The Complete Reference: AJAX," 1st Edition, Tata McGraw Hill,
   2008.
3. Web Technologies, Uttam K Roy, Oxford University Press

III-Year-II Semester	E-Commerce	L	T	P	C
PE3201		3	0	0	3

Course objectives:
The main objectives are

1. An introduction to information systems for business and management.
2. It is designed to familiarize students with organizational and managerial foundations of systems.
3. Technical foundation for understanding information systems.

Unit–1: (10 hrs)
Electronic Commerce, Frame work, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce organization applications. Consumer Oriented Electronic commerce, Mercantile Process models.

Unit–2: (9 hrs)
Electronic payment systems-Digital Token Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems

Unit–3: (9 hrs)
Inter Organizational Commerce-EDI, EDI Implementation, Value added networks. Intra Organizational Commerce-work Flow, Automation Customization and internal Commerce, Supply chain Management.

Unit–4: (10 hrs)
Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing, Information based marketing, Advertising on Internet, on-line marketing process, market research

Unit–5: (10 hrs)
Consumer Search and Resource Discovery, Information search and Retrieval, Commerce Catalogues, Information Filtering. Multimedia –key multimedia concepts, Digital Video and electronic Commerce, Desktop video processing's, Desktop video conferencing.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Demonstrate an understanding of the foundations and importance of E- commerce

CO2 Analyze the impact of E-commerce on business models and strategyDiscuss legal issues and privacy in E-Commerce

CO3 Describe Internet trading relationships including Business to Consumer, Business-to-Business, Intra-organizational.

CO4 Describe the infrastructure for E-commerce and describe the key features of Internet, Intranets and Extranets and explain how they relate to each other.

CO5 Assess electronic payment systems and recognize and discuss global E-commerce issues

Text books:

1. Frontiers of ElectronicCommerce, Kalakata, Whinston, PEA,2006.

Reference books:

1. E-Commerce Fundamentals and Applications, Hendry Chan, Raymond Lee, Dillon, Chang, John Wiley.
2. E-Commerce, A Managerial Perspective, Turban E, LeeJ, King, Chung H.M., PEA, 2001.
3. E-Commerce An Indian Perspective,3/e, P.T. Joseph, PHI, 2009.
4. E-Commerce, S.Jaiswal, Galgotia.
5. Electronic Commerce, Gary P.Schneider, Thomson

III-Year-II Semester	Principles of Programming Languages	L	T	P	C
PE3201		3	0	0	3

Course objectives:

The main objectives are

1. To introduce the various programming paradigms.
2. To understand the evolution of programming languages.
3. To understand the concepts of OO languages, functional languages, logical and scripting languages.
4. To introduce the principles and techniques involved in design and implementation modern programming languages.
5. To introduce the notations to describe the syntax and semantics of programming languages.
6. To introduce the concepts of concurrency control and exception handling.
7. To introduce the concepts of ADT and OOP for software development.

Unit–1: (10 hrs)

Preliminary Concepts: Reasons for studying concepts of programming languages, programming domains, language evaluation criteria, influences on language design, language categories, language design trade-offs, implementation methods, programming environments, Evolution of Major Programming Languages.

Syntax and Semantics: General problem of describing syntax, formal methods of describing syntax, attribute grammars, describing the meanings of programs.

Unit–2: (9 hrs)

Names, Bindings, and Scopes: Introduction, names, variables, concept of binding, scope, scope, and lifetime, referencing environments, named constants

Data types: Introduction, primitive, character, string types, user defined ordinal types, array, associative arrays, record, tuple types, list types, union types, pointer and reference types, type checking, strong typing, type equivalence

Expressions and Statements: Arithmetic expressions, overloaded operators, type conversions, relational and boolean expressions, short- circuit evaluation, assignment statements, mixed-mode assignment

Control Structures – introduction, selection statements, iterative statements, unconditional branching, guarded commands.

Unit–3: (9 hrs)

Subprograms: Fundamentals of subprograms, design issues for subprograms, local referencing environments, parameter passing methods, parameters that are subprograms, calling subprograms indirectly, overloaded subprograms, generic subprograms, design issues for functions, user defined overloaded operators, closures, co routines

Implementing subprograms: General semantics of calls and returns, implementing simple subprograms, implementing subprograms with stack-dynamic local variables, nested subprograms, blocks, implementing dynamic scoping

Abstract Data types: The concept of abstraction, introductions to data abstraction, design issues, language examples, parameterized ADT, encapsulation constructs, naming encapsulations.

Unit–4: (10 hrs)

Object Oriented Programming: Design issues for OOP, OOP in Smalltalk, C++, Java, Ada 95, Ruby, Implementation of Object-Oriented constructs.

Concurrency: introduction, introduction to subprogram level concurrency, semaphores, monitors, message passing, Ada support for concurrency, Java threads, concurrency in functional languages, statement level concurrency.

Exception Handling and Event Handling: Introduction, exception handling in Ada, C++, Java, introduction to event handling, event handling with Java and C#.

Unit–5: (10 hrs)

Functional Programming Languages: Introduction, mathematical functions, fundamentals of functional programming language, LISP, support for functional programming in primarily imperative languages, comparison of functional and imperative languages

Logic Programming Language: Introduction, an overview of logic programming, basic elements of prolog, deficiencies of prolog, applications of logic programming.

Scripting Language: Pragmatics, Key Concepts, Case Study: Python – Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.

Course Outcomes: Upon successful completion of the course, the student will be able to

- **CO1** express syntax and semantics in formal notation.
- **CO2** apply suitable programming paradigm for the application.
- **CO3** compare the features of various programming languages.
- **CO4** understand the programming paradigms of modern programming languages.
- **CO5** program in different language paradigms and evaluate their relative benefits.

Text books:

1. Concepts of Programming Languages, Robert .W. Sebesta 10th edition, Pearson Education.
2. Programming Language Design Concepts, D. A. Watt, Wiley India Edition.

Reference books:

1. Programming Languages, A.B. Tucker, R.E. Noonan, TMH.
2. Programming Languages, K. C. Louden, and K A Lambert., 3rd edition, Cengage Learning.
3. Programming Language Concepts, C Ghezzi and M Jazayeri, Wiley India.
4. Programming Languages 2nd Edition Ravi Sethi Pearson.
5. Introduction to Programming Languages Arvind Kumar Bansal CRC Press.

III-Year-II Semester	Agile Software Development	L	T	P	C
PE3201		3	0	0	3

Course objectives:

The main objectives are

1. To learn the fundamental principles and practices associated with each of the agile development methods.
2. To apply the principles and practices of agile software development on a project of interest and relevance to the student

Unit–1: (10 hrs)

Agile Software Development: Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges Lean Approach: Waste Management, Kaizen, and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality.

Unit–2: (9 hrs)

Agile and Scrum Principles: Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values Agile Product Management: Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting, and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting, and motivating the team, managing business involvement, and Escalating issue

Unit–3: (9 hrs)

Agile Requirements: User Stories, Backlog Management. Agile Architecture: FeatureDriven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools Agile Testing: Agile Testing Techniques, Test-Driven Development, User Acceptance Test.

Unit–4: (10 hrs)

Agile Review: Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles,Atern Philosophy,The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools

Unit–5: (10 hrs)
Scaling Agile for large projects: Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Analyze existing problems with the team, development process and wider organization

CO2 Apply a thorough understanding of Agile principles and specific practices

CO3 Select the most appropriate way to improve results for a specific circumstance or need

CO4 Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems

CO5 Evaluate likely successes and formulate plans to manage likely risks or problems

Text books:

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)

Reference books:

1. Succeeding with Agile : Software Development Using Scrum, Pearson (2010).

III-Year-II Semester	NPTEL/SWAYAM	L	T	P	C
PE3201		3	0	0	3

- A candidate shall complete at least one MOOC course as Professional Elective course – 2 or 5 of 12 weeks duration.
- Enrolment of MOOC course will be initiated from the date of commencement of classwork for Second Year – 2nd Semester.
- MOOC course completion certificate must be submitted on or before the completion of Fourth Year – 1st Semester to consider it for Regular evaluation. Otherwise it will be considered as Supplementary.
- Student has to pursue and acquire a certificate for a MOOC course only from the SWAYAM/NPTEL through online with the approval of Head of the Department concerned in order to earn the 3 credits.
- List of courses will be announced by the respective Board of Studies at the time of commencement of class work for Second Year – 2nd Semester.

III-Year-II Semester	E-Waste Management (Open Elective-2)	L	T	P	C
OE3201		3	0	0	3

Course objectives:

The main objectives are

1. To provide a better understanding of the key aspects of e- waste management and international case studies, legal aspects, and effective management practices of e-waste.

Unit–1: (10 hrs)

Introduction.

E- Waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal.

Unit–2: (9 hrs)

E- Waste legislation

E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs. The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment, Restrictions of Hazardous Substances (RoHS) Directive.

Unit–3: (9 hrs)

E-Waste hazardous on Global trade

Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.

Unit–4: (10 hrs)

E-Waste control measures

Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source.

Unit–5: (10 hrs)

E-Waste management Techniques

Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Know about the environmental impacts of e-waste.

CO2 Analyze the E- waste management measures proposed under national and global legislations

CO3 Apply various concept learned under e-waste management hierarchy.

CO4 Distinguish the role of various national and internal act and laws applicable

CO5 Know about E-waste management and handling.

Text books:

1. Hester R.E., and Harrison R.M. 2009. Electronic Waste Management. Science.
2. Fowler B. 2017. Electronic Waste – 1 st Edition (Toxicology and Public Health Issues). Elsevier.

Reference books:

1. Johri R., “E-waste: implications, regulations, and management in India and current global best practices,” TERI Press, New Delhi

III-Year-II Semester	Semantic Web and Social Networks (Open Elective-2)	L	T	P	C
OE3201		3	0	0	3

Course objectives:

The main objectives are

1. To learn Web Intelligence
2. To learn Knowledge Representation for the Semantic Web
3. To learn Ontology Engineering
4. To learn Semantic Web Applications, Services and Technology
5. To learn Social Network Analysis and semantic web
6. To understand the role of ontology and inference engines in semantic web
7. To describe how the Semantic Web provides the key in aggregating information across heterogeneous sources.

Unit–1: (10 hrs)

Web Intelligence Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web

Unit–2: (9 hrs)

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema.

Unit–3: (9 hrs)

Ontology Engineering Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule, and Inference Engines

Unit–4: (10 hrs)

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents, and Semantic Methods

Unit–5: (10 hrs)

Social Network Analysis and semantic web What is social Networks analysis, Development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Explore basics of Web and Semantic Web
CO2 Summarize knowledge representations in Web ontologies
CO3 Demonstrate inferences in Ontology engineering
CO4 Demonstrate different types of semantic web applications
CO5 Explore social network analysis

Text books:

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

Reference books:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies, R.Studer, P.Warren, John Wiley & Sons.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman.

III-Year-II Semester	Software Project Management (Open Elective-2)	L	T	P	C
20IT6O02		3	0	0	3

Course objectives:

The main objectives are

1. To study how to plan and manage projects at each stage of the software development life cycle (SDLC)
2. To train software project managers and other individuals involved in software project planning
3. To Study Tracking and oversight in the implementation of the software project management process.
4. To understand successful software projects that support organization's strategic goals.
5. To study Software Project monitoring and control, software quality.

Unit–1: (10 hrs)

Introduction Project, Management, Software Project Management activities, Challenges in software projects, Stakeholders, Objectives & goals Project Planning: Step-wise planning, Project Scope, Project Products & deliverables, Project activities, Effort estimation, Infrastructure

Unit–2: (9 hrs)

Project Approach Lifecycle models, Choosing Technology, Prototyping Iterative & incremental Process Framework: Lifecycle phases, Process Artifacts, Process workflows

Unit–3: (9 hrs)

Effort estimation & activity Planning Estimation techniques, Function Point analysis, SLOC, COCOMO, Use case-based estimation , Activity Identification Approaches, Network planning models, Critical path analysis.

Unit–4: (10 hrs)

Risk Management& Risk categories: Identification, Assessment, Planning and management, PERT technique, Monte Carlo approach.

Project Monitoring & Control, Resource Allocation

Creating a framework for monitoring & control, Progress monitoring, Cost monitoring, Earned value Analysis, Defects Tracking, Issues Tracking, Status reports, Types of Resources, Identifying resource requirements, Resource scheduling.

Unit–5: (10 hrs)

Software Quality and Planning Quality: Defining Quality – ISO 9126, Quality Measures, Quantitative Quality Management Planning, Product Quality & Process Quality Metrics, Statistical Process Control Capability Maturity Model, Enhancing software Quality.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Match organizational needs to the most effective software development model and to understand the basic concepts and issues of software project management

CO2 Effectively Plan the software projects and to implement the project plans through managing people, communications, and change

CO3 Select and employ mechanisms for tracking the software projects

CO4 Conduct activities necessary to successfully complete and close the Software projects

CO5 Develop the skills for tracking and controlling software deliverables

Text books:

1. Software Project Management, Bob Hughes & Mike Cotterell, TATA Mcgraw-Hill
2. Software Project Management, Walker Royce: Pearson Education, 2005.
3. Software Project Management in practice, Pankaj Jalote, Pearson

Reference books:

1. Software Project Management, Joel Henry, Pearson Education

III-Year-II Semester	Environment Pollution and Control (Open Elective-2)	L	T	P	C
OE3201		3	0	0	3

Course objectives:

The main objectives are

1. To introduce the concepts of Air Pollution and the control methods.
2. To impart the knowledge of the Solid Waste generation problem.
3. To familiarize the best practices for management of solid wastes adopted at the service provider level.
4. To elucidate noise pollution problems and emphasize the necessity to control them

Unit–1: (10 hrs)

Air Pollution

Definitions, scope, significance, and episodes – Types of pollutants, their sources, and impacts (on plants, animals, materials) – Classifications, natural & artificial, primary & secondary, point &non point, linear & areal sources, stationary & mobile – Sampling and analysis of air pollutants – Ambient air quality standards by WHO (World Health Organization) & CPCB (Central Pollution Control Board).

Air Pollution Meteorology

Properties of atmosphere: heat, pressure, wind forces, moisture, and relative humidity – Lapse rates – Influence of terrain and meteorological phenomena on plume behavior and air quality – Wind rose diagrams, plume rise models.

Unit–2: (9 hrs)

Air Pollution Control and Monitoring

Control of particulates: control at sources, process changes, equipment modifications – Design and operation of control equipments, settling chambers, cyclone separators, fabric filters, scrubbers, electrostatic precipitators – Control of gases like SOx , NOx , CO and HC, Air-fuel ratio, computation, and control of products of combustion – Monitoring of SPM, SO2 , NOx and CO, Stack Monitoring for flue gases

Unit–3: (9 hrs)

Solid Waste Generation and Collection

Characteristics – types, sources, and properties of solid waste – Generation, typical generation rates, estimation of solid waste quantities, factors that affect generation of wastes – Collection services, types of collection systems, determination of vehicle and labour requirement and transportation of solid waste – Transfer stations, transfer means and methods.

Unit–4: (10 hrs)

Solid Waste Management and Disposal

Engineered systems for solid waste management (refuse, reduce, reuse, recover, recycle) – Reuse of solid waste materials, processing techniques, materials recovery system, recovery of biological, thermal conversion products and recovery of energy from conversion products – Recycling of segregated waste materials – Ultimate Disposal of solid waste (Land filling, incineration, composting)

Unit–5: (10 hrs)

Noise Pollution and Control

Sources of noise pollution, impacts of noise, measurement of noise and permissible limits of noise, control methods of noise pollution, The Noise Pollution (Regulation and Control) Rules, 2000 as per CPCB.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Evaluate the ambient air quality based on the analysis of air pollutants and relate the polluting plume behavior with weather data

CO2 Identify suitable control methods depending on the severity and type of air pollution

CO3 Classify solid wastes and identify suitable collection and transfer mechanisms

CO4 Suggest suitable solid waste management methods based on the nature of solid waste and the quantities to be handled

CO5 Identify the sources of noise pollution and suggest methods for mitigating the problem

Text books:

1. Air Pollution, M.N.Rao, H.V.N.Rao, 1st Edition, McGraw Hill Education.
2. Solid and Hazardous Waste Management, M.N.Rao, Razia Sultana, 1st Edition, BS Publications.
3. Noise Pollution and Its Control,H.C.Bhatia, 1st Edition, Atlantic Publisher.

Reference books:

1. Advanced Air and Noise Pollution Control, Lawrence K.Wang, Norman C. Pereira, Yung-Tss Hung, 2005 Edition, Humana Press.
2. Municipal Solid Waste Management, P.Jayarama Reddy, 1st Edition, B.S.Publications

III-Year-II Semester	Embedded Real Time Operating Systems Lab	L	T	P	C
20CO6L01		0	0	3	1.5

Course objectives:
The main objectives are
1. To introduce various hardware and hardware tools required for the development of real-time systems.
2. To impart knowledge of programming the real-time systems on open-source Linux operating system.
3. To introduce and implement the operational concepts such as interrupt handling, threads, and resource allocation strategies in real-time scenarios.
4. To familiarize the real-time development platform based on the popular NXP LPC2148 microcontroller boards.

List of Experiments
Embedded Systems Laboratory (Any 6 Experiments)
1. Study Of EDU-ARM-2148 Trainer kit
2. Study of IDE overview-Project creation, downloading &debugging.
3. Write a Program to Blink LED: Generate any four random patterns on LED Matrix.
4. Write a program to interface LCD 7. Write a program to interface 4*4 matrix keyboard
5. Write a program to interface 7SEG (7 segment display).
6. Write a program to interface buzzer with ARM
7. Write a program to interface 2 relays with LPC2148.
8. Write a program to generate a square wave using ARM.

Real-Time Operating Systems (Any 5 Experiments)
1. Write the pseudo code in Linux using C/C++ to perform FCFS scheduling
2. Write the pseudo code in Linux using C/C++ to perform Round Robin scheduling.
3. 3 Write the pseudo code in Linux using C/C++ to perform Priority Based scheduling.
4. 4 Write the pseudo code in Linux using C/C++ to perform Print parent process
5. ID & child process ID using Fork().
6. Study of Semaphore & Write appropriate the pseudo code in Linux using C/C++.
7. Write appropriate the pseudo code for Pipe in Linux.

Hardware Requirements:
- Any ARM LPC2148 board

- Sensors
- A PC with 4 GB RAM,
- WINDOWS and LINUX based Operating System

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand hardware and hardware tools required for the development of real-time systems

CO2 Gain knowledge of programming the real-time systems on open-source Linux operating system

CO3 Implement the operational concepts such as interrupt handling, threads, and resource allocation strategies in real-time scenarios

CO4 Get familiarity with the real-time system programming on anu microcontroller boards

III-Year-II Semester	Mobile Application Development for IoT Lab	L	T	P	C
20CO6L02		0	0	3	1.5

Course objectives:
The main objectives are
1. To understand the installation of Android SDK
2. To explore various features of Android SDK tools
3. To explore various components in Android SDK

List of Experiments

1. Procedure to install Android Studio.
2. Develop a sample "Hello World Application.
3. Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button.
4. Create a screen that has input boxes for User Name, Password, Address, Gender(radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout).
5. Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity.
6. Design an android application Send SMS using Intent.
7. Create an android application using Fragments.
8. Design an android application for menu.
9. Design an android application to display list of fruits using Listview
10. Design an android application to display list of users using Recyclerview from internet.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Explore features of Android SDK
CO2 Explore various components in GUI development through Android
CO3 Experiment different applications through Android SDK

III-Year-II Semester	**Front End Application Development Lab**	**L**	**T**	**P**	**C**
20CO6L03		**0**	**0**	**3**	**1.5**

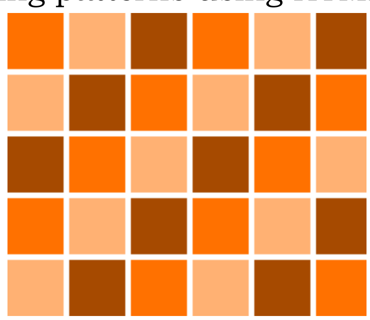
Course objectives:

At the end of the course the students will understand

1. Higher order functions
2. Class Components.
3. Functional Components.
4. Different types of Hooks.
5. React application with data base connectivity.

List of experiments

1. Try to recreate the following patterns using HTML and CSS only.



2. Implement Drag n Drop feature in HTML 5
3. Demonstrate Event bubbling with necessary examples.
4. Design a Calculator using Java script and relevant CSS.

5. Demonstrate Higher order functions with necessary examples – filter(), reduce() and map()
6. Create a Class Component for Counter in React JS
7. Create a Class component for Changing the color of the text given in React JS
8. Class a Class Component for viewing an array of objects in a tabular form.
9. Display a digital clock in React JS.
10. Demonstrate useState Hook with the help sample text.
11. Demonstrate useContext Hook with necessary example.

12. Demonstrate useEffect Hook with necessary example.
13. Demonstrate consuming web API using fetch & axios (AXIOS API). Demonstrate with the help of fake URL.
14. Design a BMI calculator using React JS based on the description given below:

BMI is a measurement of a person's leanness or corpulence based on their height and weight, and is intended to quantify tissue mass. It is widely used as a general indicator of whether a person has a healthy body weight for their height.

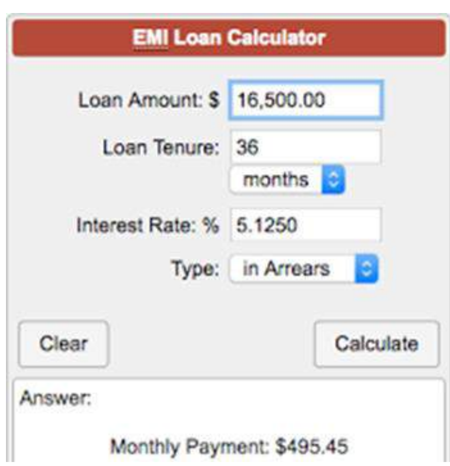
Formula:

weight (kg) / [height (m)]2 (or) [weight (kg) / height (cm) / height (cm)] x 10,000

BMI table for adults: This is the World Health Organization's (WHO) recommended body weight based on BMI values for adults. It is used for both men and women, age 18 or older.

Category	BMI range - kg/m^2
Severe Thinness	< 16
Moderate Thinness	16 - 17
Mild Thinness	17 - 18.5
Normal	18.5 - 25
Overweight	25 - 30
Obese Class I	30 - 35
Obese Class II	35 - 40
Obese Class III	> 40

15. Display a selected set of images in tabular format using React JS.
16. Implement Upload & down load options on a given file.
17. Create a React application to view EMI calculator. A specific view is given below:



$$E = P \times r \times \frac{(1+r)^n}{(1+r)^n - 1}$$

Where,

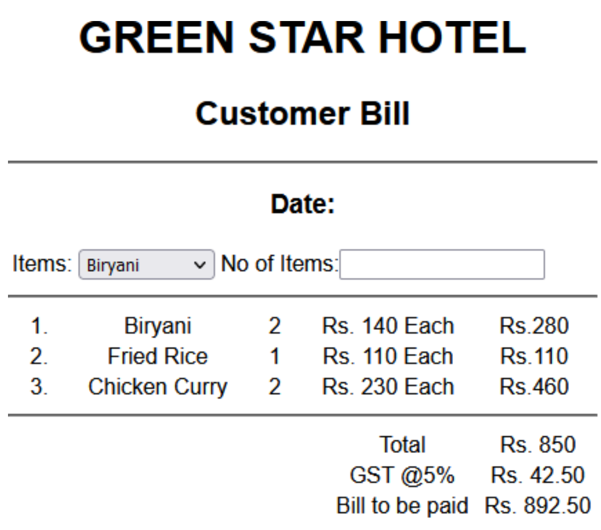
E is the EMI

P is the principal amount

r is the monthly rate of interest

n is the number of months

18. Design the following Hotel bill screen. User can select as many items as possible from the dropdown box and is allowed to enter in the text field provided. Each transaction must be added in the table given below along with the bill amount.



19. Demonstrate the procedure to create a schema in MongoDB.
20. Demonstrate CRUD operations using MongoDB

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Use Higher Order functions like filter(), reduce(), map()
CO2 Develop a react application using class components
CO3 Develop a react application using functional components
CO4 Develop a complete react application with data base connectivity

III-Year-II Semester	Soft skills	L	T	P	C
20CO6E01		0	0	4	2

Preamble:

Soft skills are character traits and interpersonal skills that portray a person's relationships with other people. In the workplace, soft skills are considered to be a balance to hard skills, which refer to a person's knowledge and professional skills.

Course objectives:

The main objectives are

1. To communicate clearly, confidently, concisely, and persuasively both written as well as orally.
2. To rediscover and boost self-confidence, to the zenith, and solve issues with ease.
3. To recognize the results (change) of their behavior / conduct and teach them to take ownership of their acts rather than blaming others.
4. To build confidence in their speaking / presentation skills and become industry-ready.
5. To develop a stronger sense of consciousness and appreciation for others by analyzing prospects, and creating choices.
6. To manage self-competence and self-confidence

Module 1 Effective communication skills

- ✓ Start with self and connect with others.
- ✓ The art of narrating and storytelling.
- ✓ Enhance teamwork and influence change.

Module 2 Advanced verbal ability concepts – practice and Professional writing skills

- ✓ Nurture and enhance the verbal ability strength through practice.
- ✓ Conducting mock verbal (ability) tests and their timely review.
- ✓ List the steps of writing an email effectively & comprehend the importance of structuring an email.
- ✓ Overview of various elements related to accuracy, brevity, and correctness in our everyday writing at the workplace (Project proposals / covering letters / blogs / short essays).

Module 3 Industry sneak and résumé / CV building strategies

- ✓ Industry & aspirant career expectations and tailoring action learning plan aptly.
- ✓ Crafting winning résumé(s) suiting to different profiles.
- ✓ Framing responses to resume based interview questions.

Module 4 Behavioral competency building – Part II and psychometric test (HR Round Preparation)

- ✓ Listing personal characteristics and preparing blueprint to inculcate them.
- ✓ Assess the students' ability to fit into a specific work environment or with specific personality types.
- ✓ Determine basic characteristics of an individual.

Module 5 Presentation skills & Mock interviews

- ✓ Illustration of presentation structure via impromptu / free speech – and essential criteria for an effective presentation
- ✓ Importance of non-verbal communication (signposting)
- ✓ Inciting the interview process by practicing a gamut of behavioral mock interviews.

Module 1 –Tasks

- ✓ Listening & comprehension skills – lessons from the corporate training videos / scenes in films.
- ✓ Role play – story telling & anchoring
- ✓ Extempore – students' experience with college/program.
- ✓ Listening & comprehension skills – lessons from the corporate training videos / scenes in films

Module 2 -Tasks

- ✓ Story paraphrasing, peer introduction and monologue.
- ✓ Assignment on short essay and blog building/digital profile creation.

Module 3 -Tasks

- ✓ Overview & analysis of a Job Description(JD) and its reflection in resume / self introduction
- ✓ Crafting of resumes by mapping skills & competences to different profiles offered for engineering graduates.
- ✓ An act on – one day in the life of an HR manager/ Project leader etc.

Module 4 -Tasks

- ✓ Case scenarios – to identify behavioral competencies and personality traits
- ✓ increase self-awareness and improve interactions with others

Module 5 -Tasks

- ✓ Pair & Group work – debating / demonstration of product promotion, etc.
- ✓ Peer mock interview practice on selected profiles.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 master advanced nuances of both written and oral communication skills that are imperative for any professional to succeed coupled with being emphatic.

CO2 confidently ace different competitive exams and develop writing skills.

CO3 gain awareness of the industry expectations and craft CV / Résumé in lieu with desired job profiles.

CO4 crack behavioral (HR) interview confidently and exhibit professional persona.

CO5 make presentations effective and develop interview strategies while get rid of interview phobia.

Text books:

1. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
2. Barun K. Mitra, “Personality Development & Soft Skills,” Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R., and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership,” John Wiley & Sons, 2004.
5. Kalyana, “Soft Skill for Managers;” First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, “The First Book of Life Skills;” First Edition, Embassy Books, 2016.
7. Shalini Verma, “Development of Life Skills and Professional Practice;” First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, “Soft Skills for Everyone,” Cengage Learning India Pvt. Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6th Edition, 2015.

E-Resources:

1. Infosys Springboard (https://infyspringboard.uk.onwingspan.com/web/en/login)
2. AICTE Digital Learning Portal (https://free.aicte-india.org/)

3. APSCHE LMS – Bringing Learning to People (https://apschelms.e-pragati.in/#/)
4. Dale Carnegie Academy (https://www.dalecarnegie.com/en)
5. TedX Program (https://www.ted.com/about/programs-initiatives/tedx-program)
6. Toast Masters International (https://www.toastmasters.org/)
7. NPTEL (https://nptel.ac.in/)
8. Coursera / Udemy / Unacademy / Wikipedia (https://en.wikipedia.org/wiki/Main_Page)

III-Year-II Semester	Entrepreneurial Skill Development	L	T	P	C
20SH6N01		2	0	0	0

Course objectives:

The main objectives are

1. To provide an intensive & in-depth learning to the students in field of entrepreneurship.
2. To encourage students to opt for self-employment as an alternative career option.
3. To enable students to appreciate the dynamic changes happening in the economy.
4. To acquaint the students about the role of Entrepreneurship in the growth and economic development of the nation.
5. To analyze the role of government and non-government institutions in supporting entrepreneurial activities.

Unit–1: (10 hrs)

Entrepreneurship and Entrepreneurial opportunity

Entrepreneurship – Concept, Advantage and Limitations of Entrepreneurship -Myths about Entrepreneurship -Why Entrepreneurship -Functions and Need of Entrepreneurship Types of Entrepreneurs- Why be an Entrepreneur- –Process of Entrepreneurship- Entrepreneurship-Indian Scenario. Intrapreneur: Meaning and Importance.

Sensing Entrepreneurial Opportunities, Environment Scanning, Problem Identification, Idea fields, Spotting Trends, Creativity and Innovation, Selecting the Right Opportunity

Unit–2: (10 hrs)

Entrepreneurship Journey & Entrepreneur Planning

Feasibility Study and opportunity-Idea generation -Business Plan: meaning, purpose and elements, Business Plan: concept, Execution of Business Plan.

Components: Organizational plan; Operational plan; Production plan; Financial plan; Marketing plan; Human Resource planning.

Unit–3: (9 hrs)

Entrepreneurship as Innovation and Problem Solving, Enterprise Marketing:

Entrepreneurs as problem solvers , Innovations and Entrepreneurial Ventures– Global and Indian ,Role of Technology – E-commerce and Social Media, Social Entrepreneurship – Concept.

Marketing and Sales Strategy, Branding, Logo, Tagline, Promotion Strategy

Unit–4: (9 hrs)

Enterprise Growth Strategies and Women & Rural Entrepreneurship:

Mergers and Acquisition: Concept, reasons, and types -Angel Investor: Features -Venture Capital: Features, funding.
Women Entrepreneurship: Meaning- need, scope, growth and problems of women entrepreneurs, Special Schemes for Women Entrepreneurs.
Rural Entrepreneurship-Meaning-Need-Scope-Problems faced by Rural Entrepreneurs-Entrepreneurship development in rural area-Special Schemes for Rural Entrepreneurs.

Unit–5: (10 hrs)

Institutions Supporting Entrepreneurship

A brief overview of financial institutions in India- Central level and state level institutions-SIDBI-NABARD-IDBI-SIDCO-Indian Institute of Entrepreneurship -DIC-Single Window-Latest Industrial Policy of Government of India.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 The basics of entrepreneurship skills for better understanding of the scenario of Entrepreneurial activity in India

CO2 Understand the basic plan and the various components of business plan

CO3 Understand the role of entrepreneurs as problem solvers and the various marketing strategies used in a business

CO4 Understand the concept of growth & development of an enterprise and to identify entrepreneurial opportunities for women and analyze Entrepreneurship development in rural area.

CO5 Understand government role supporting entrepreneurship

Project work:

Option 1: Wadhwani Program by IUCEE.
Option 2: Students have to do one project in the entire academic session.

TOPICS FOR THE PROJECT:

1. Business Plan
2. Market Survey

Note: 1. Project work /IUCEE programme is not mandatory for credit course.

2. Project work /IUCEE programme is mandatory for non credit course so students should complete any one of the projects above, and attends the project review for the same.

Text books:

1. Entrepreneurial Development - S.S. Khanka
2. Entrepreneurial Development - Satish Taneja & Dr.S.L. Gupta

3. Entrepreneurial Development - P.C. Shejwalkar
4. Fundamental of Entrepreneurship – Dr. A.K. Gavai
5. Khanna, S. S., Entrepreneurial Development, S. Chand, New Delhi.
6. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
7. P.Narayana Reddy, Entreprenurship, Cengage Learning, New Delhi,2010.
8. Arya Kumar: “Entrepreneurship,” Pearson, Publishing House, New Delhi, 2012.
9. VSP Rao, Kuratko: “Entrepreneurship,’ Cengage Learning, New Delhi, 2011.
10. K.Ramachandran: “Entrepreneurship Development,” TMH, New Delhi, 2012.

Reference books:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. Entrepreneurship, a South – Asian Perspective, D.F. Kuratko and T. V. Rao, 3e, Cengage, 2012.
3. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.
4. AnajanRai Chaudhuri, Managing new ventures, concepts, and cases, Prentice Hall International, 2010.
5. Rajeev Roy: Entrepreneurship, Oxford university press, New Delhi, 2010.

E-Resources:

1. https://nptel.ac.in/courses/110105067/50
2. http://www.yourarticlelibrary.com/project-management/5-methods-of-project-appraisalexplained/40771
3. https://springhouse.in/government-schemes-every-entrepreneur/
4. http://nptel.ac.in/courses
5. https://www.tutorialspoint.com/
6. https://www.ediindia.org/
7. http://www.quickmba.com/entre/

IV-Year-I Semester	Universal Human Values -2: Understanding Harmony	L	T	P	C
HSE4101		3	0	0	3

Course objectives:
The students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

Unit–1: (10 hrs)
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education
1. Purpose and motivation for the course, recapitulation from Universal Human Values-I 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
Unit–2: (9 hrs)
Understanding Harmony in the Human Being - Harmony in Myself!
7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility 9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 10. Understanding the characteristics and activities of 'I' and harmony in 'I' 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 12. Programs to ensure Sanyam and Health.
Unit–3: (9 hrs)
Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship
13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 14. Understanding the meaning of Trust; Difference between intention and competence 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as

comprehensive Human Goals 17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit–4: (10 hrs)

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature 20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space 21. Holistic perception of harmony at all levels of existence.

Unit–5: (10 hrs)

Implications of the above Holistic Understanding of Harmony on Professional Ethics

22. Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 26. Case studies of typical holistic technologies, management models and production systems 27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers b. At the level of society: as mutually enriching institutions and organizations

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understanding the content and process for value education.

CO2 Understanding the harmony in the human being, family, society, and nature/existence

CO3 Apply the Strengthening of self-reflection.

CO4 Apply to All levels become sensitive to their commitment towards what they have understood (human values, human relationship, and human society)

CO5 Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.

Text books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

IV-Year-I Semester	Human Resource Development	L	T	P	C
HSE4101		3	0	0	3

Course objectives:
The main objectives are
1. To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
2. To help the students focus on and analyse the issues and strategies required to select and develop manpower resources
3. To develop relevant skills necessary for application in HR related issues
4. To Enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

Unit–1: (10 hrs)
Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate
Unit–2: (9 hrs)
Micro Perspective: Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD.
Unit–3: (9 hrs)
Instructional Technology for HRD : Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behaviour Modelling and Self-Directed Learning; Evaluating the HRD
Unit–4: (10 hrs)
Human Resource Training and Development : Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training Managers
Unit–5: (10 hrs)
Training Methods: Training with in Industry (TWI): On the Job & Off the Job Training; Management Development: Lecture Method; Role Play; In-basket Exercise; Simulation; Vestibule Training; Management Games; Case Study; Programmed Instruction; Team Development; Sensitivity Training; Globalization challenges and Strategies of Training Program, Review on T&D Programmes in India.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 To develop the understanding of the concept of human resource management and to understand its relevance in organizations.

CO2 To develop necessary skill set for application of various HR issues.

CO3 To analyse the strategic issues and strategies required to select and develop manpower resources.

CO4 To integrate the knowledge of HR concepts to take correct business decisions.

Text books:

1. Nadler, Leonard :Corporat Human Resource Development, Van Nostrand Reinhold, ASTD, New York .
2. Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005

Reference books:

1. Rao, T.V: Readings in HRD, Oxford IBH Pub. Pvt. Ltd., New Delhi , 2004.
2. Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, NewDelhi . 5.
3. T.V.(et.al): HRD in the New Economic Environment, Tata McGraw-Hill Pub.Pvt, Ltd., New Delhi , 2003.

IV-Year-I Semester	**Business Intelligence**	**L**	**T**	**P**	**C**
HSE4101		**3**	**0**	**0**	**3**

Course objectives:

The main objectives are

1. This course is concerned with extracting data from the information systems that deal with the day-to-day operations and transforming it into data that can be used by businesses to drive high-level decision making
2. Students will learn how to design and create a data warehouse, and how to utilize the process of extracting, transforming, and loading (ETL) data into data warehouses.

Unit–1: (10 hrs)

Introduction to Business Intelligence: The Business Pressure-Responses and support model Definition of BI- Architecture of BI- Styles of BI-vent-Driven alerts-A cyclic process of Intelligence Creation. The value of Business Intelligence-Value driven and Information use Performance metrics and key performance indicators-horizontal use cases for BI.

Unit–2: (9 hrs)

Data Ware Housing: Definitions and concepts-DW process an Innovation-Data Warehousing Implementation-Data warehousing Administration-Security Issues and future trends. Business Performance Management-Overview Strategic plan, monitor, performance measurement, BPM methodologies-BPM Techniques-Performance dashboard and scorecards.

Unit–3: (9 hrs)

Data Mining for Business Intelligence: Data mining concepts and definitions-Data mining applications - Artificial neural Networks for data mining - Text and web mining-Natural language processing-Text mining applications-Text mining process-tools-Web mining overview Web content overview-Web structure mining-Web usage mining.

Unit–4: (10 hrs)

Business Rules: The Value Preposition of Business Rules - Business rules approach-Business rule system - Sources of business rules and management approach.

Unit–5: (10 hrs)

Business Intelligence Implementation: Business Intelligence and integration - Implementation – connecting in BI systems- Issues of legality- Privacy and ethics- Social networking and BI. Relevant cases have to be discussed in each unit and in examination case is compulsory from any unit.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand architecture of data warehouse and OLAP operations.
CO2 Understand Fundamental concepts of BI and Analytics.
CO3 Application of BI Key Performance indicators
CO4 Design of Dashboards, Implementation of Web Analytics
CO5 Understand Utilization of Advanced BI Tools and their Implementation
CO6 Implementation of BI Techniques and BI Ethics.

Text books:

1. Amit Johri "Business Intelligence" Himalaya, 2012
2. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012

Reference books:

1. Carlo Vercellis "Business Intelligence" Wiley Publications, 2012
2. Nina Godbole&SunitBelapure" Cyber Security" Wiley india 2012.
3. Jawadekar, MIS Text and Cases, TMH, 2012
4. Efraim Turban et al. "Business Intelligence" 2e, Pearson Education, 2012

IV-Year-I Semester	Management and Organizational Behaviour	L	T	P	C
HSE4101		3	0	0	3

Course objectives:

The main objectives are

1. To give a basic perspective of Management theories and Practices.
2. To study other functional areas of management
3. To Provide the students with the conceptual framework and the theories underlying Organizational Behaviour

Unit–1: (10 hrs)

Nature of Management - Social Responsibilities of Business - Manager and Environment Levels in Management - Managerial Skills - Planning - Steps in Planning Process - Scope and Limitations – Short Range and Long-Range Planning - Flexibility in Planning ¬Characteristics of a sound Plan – Management by Objectives (MBO) - Policies and Strategies - Scope and Formulation - Decision Making – Techniques and Processes.

Unit–2: (9 hrs)

Organising - Organisation Structure and Design - Authority and Responsibility Relationships – Delegation of Authority and Decentralisation - Interdepartmental Coordination - Emerging Trends in Corporate Structure, Strategy and Culture - Impact of Technology on Organisational design - Mechanistic vs Adoptive Structures - Formal and Informal Organisation.

Unit–3: (9 hrs)

Perception and Learning - Personality and Individual Differences - Motivation and Job Performance - Values, Attitudes and Beliefs - Stress Management - Communication Types-Process - Barriers – Making Communication Effective.

Unit–4: (10 hrs)

Group Dynamics - Leadership - Styles - Approaches - Power and Politics - Organisational Structure - Organisational Climate and Culture - Organisational Change and Development.

Unit–5: (10 hrs)

Comparative Management Styles and approaches - Japanese Management Practices Organisational Creativity and Innovation - Management of Innovation - Entrepreneurial Management - Benchmarking - Best Management Practices across the world - Select cases of Domestic & International Corporations - Management of Diversity.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 understand the conceptual framework of the discipline of OB and its practical applications in the organizational set up.

CO2 understand the role of individual, groups and structure in achieving organizational goals effectively and efficiently.

CO3 evaluate and analyze various theories and models that contributes in the overall understanding of the discipline.

CO4 develop creative and innovative ideas that could positively shape the organizations.

CO5 accept and embrace in working with different people from different cultural and diverse background in the workplace.

Text books:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behaviour, Pearson, 16e, 2017.
2. Richard L. Daft, New Era of Management, Cengage Learning, 11e, 2017.
3. Afsaneh Nahavandi, Robert B. Denhardt, Janet V. Denhardt, Maris P. Aristigueta, Organizational Behaviour, Sage Publications, 2015.
4. Ricky W Griffin, Management Principles and Practices, Cengage Learning, 11e, 2017.
5. Laurie J. Mullins, Management and Organizational Behaviour, Pearson Publications, 9e, 2017
6. Ramesh B. Rudani, Management and Organizational Behaviour Tata McGraw hill, 2011.

Reference books:

1. Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley, 9th Edition, 2008.
2. UdaiPareek, Understanding Organisational Behaviour, 2nd Edition, Oxford Higher Education, 2004.
3. Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.

IV-Year-I Semester	Strategic Management	L	T	P	C
HSE4101		3	0	0	3

Course objectives:

The main objectives are

1. To introduce the concepts of strategic management and understand its nature in competitive and institutional landscape.
2. To provide an underpinning of strategy formulation process and frameworks, tools and techniques of strategic analysis and its application.
3. To develop a holistic approach to see business issues comprehensively and using other core and functional subject knowledge for decision-making
4. Identification, appreciation and interpretation of the critical challenges and opportunities before an organization.

Unit–1: (10 hrs)

Introduction

Meaning, Scope and Importance of Strategic Management, Nature of Strategic Management, Characteristics, Strategic Management Process, Strategic Management Model, Dimension and Levels of Strategy, Role of strategists in business Policy.

Unit–2: (9 hrs)

Strategy Formulation

Corporate Planning, Concept of Planning, Planning Process, Types of Planning, Strategic Planning, Strategic Decision Making, Vision, mission, and purpose, objectives and goals of a business organization-Types of strategies –Guidelines for crafting successful business strategies.

Unit–3: (9 hrs)

Environmental Appraisal, External Analysis: Industry analysis, remote environment analysis, competitive analysis, global environmental analysis, Internal Analysis: Resource-based view of the firm, Capabilities, core competence, value chain analysis, VRHN analysis, distinctive competency, sustainable competitive advantage and profitability, SWOT Analysis, Synergy.

Unit–4: (10 hrs)

Strategic Analysis and Choice, Environmental Threat, and Opportunity Profile (ETOP); BCG, TOWS, GE, Directional Policy Matrix-Organizational Capability Profile –Strategic Advantage Profile Corporate Level strategies-growth, stability, renewal, corporate portfolio analysis, grand strategies, McKinsey's7s Framework. Business Level Strategies-Michael Porter's Generic strategies, Functional level strategies.

Unit–5: (10 hrs)

Strategy Implementation and Evaluation, Strategy Implementation: Structure,

Systems and People, issues in implementation, Model of Strategic Implementation, Project implementation, Procedural implementation, Resource Allocation, Budgets, Organization Structure, Strategy and
Organisation Structure, Different Types of Organisational Structure, Social responsibilities and Ethics- Building a capable organization-Functional issues. Symptoms of malfunctioning of strategy-Operations Control and Strategic Control, An overview of Strategic Evaluation and Control-Measurement of performance-Analyzing variances-Role of organizational systems in evaluation. Strategic Management for non-profit organizations

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 describe major theories, background work, concepts, and research output in the field of strategic management.

CO2 demonstrate a clear understanding of the concepts, tools & techniques used by executives in developing and executing strategies and will appreciate its integrative and interdisciplinary nature.

CO3 demonstrate effective application of concepts, tools & techniques to practical situations for diagnosing and solving organisational problems

CO4 demonstrate capability of making their own decisions in dynamic business landscape.

CO5 develop their capacity to think and execute strategically.

Text books:

1. Strategic Management, Fred R. David, Pearson Education
2. Strategic Management and Business Policy, Thomas L Wheelen, J. David Hunger and Krish Rangarajan, Pearson Education

Reference books:

1. Strategic Management: An Integrated approach, Hill W.L. Charles & Jones R. Gareth
2. Business Policy and Strategic Management, AzharKazmi, Tata McGraw Hill
3. Strategic Management -The Indian Context, R.Srinivasan, Prentice Hall of India, 2012.

IV-Year-I Semester	Industrial and Medical IoT (Professional Elective-3)	L	T	P	C
PE4101		3	0	0	3

Course objectives:

The main objectives are

1. To provide students with good depth of knowledge of Designing Industrial and Medical IoT Systems for various applications.
2. Students will learn the new evolution in hardware, software, and data
3. Able to understand the application areas of IoT.
4. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks

Unit–1: (10 hrs)

Introduction to Industrial IoT: Technical requirements, IoT Background-History and definition, IoT enabling factors, IoT applications, IoT key technologies, I-IoT, IoT and I-IoT – similarities and differences, Industry environments and scenarios covered by I-IoT.

Unit–2: (9 hrs)

Understanding the Industrial Process and Devices Technical requirements: The industrial process-Automation in the industrial process, Control and measurement systems, Types of industrial processes.

Unit–3: (9 hrs)

Industrial Data Flow and Devices : Technical requirements, The I-IoT data flow in the factory, Measurements, and the actuator chain .Sensors , The converters - Digital to analogical , Analog to digital, Actuators, Controllers - Microcontrollers, Embedded microcontrollers, Microcontrollers with external memory, DSP's. Industrial protocols -Automation networks, the fieldbus, Developing Industrial IoT and Architecture Introduction to the I-IoT platform and architectures, OSGi, micro service, containers, and server less computing, The standard IIoT flow.

Unit–4: (10 hrs)

Internet of Medical Things Introduction and system architecture: Introduction, IoMT Devices-On-Body Devices, in home Devices, Community Devices, in Clinic Devices, in Hospital Devices, IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer.

Unit–5: (10 hrs)

Internet of Medical Things Security Threats, Security Challenges and Potential Solutions: IoMT Attack Types, Challenges in IoMT Security Schemes, Current Security Plans for IoMT, Potential Solutions for Security Vulnerabilities.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the basics of Industrial IoT and Medical IoT

CO2 Identify the technical and industrial requirement procedures for IIoT applications

CO3 Develop various applications using IIoT architectures

CO4 Choose selected IoT devices for understanding the system architecture of medical IoT

CO5 Analyze privacy and security measures for industry and medical standard solutions

Text books:

1. Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd., Packt Publishing Ltd, 2018.
2. D. Jude Hemanth and J. Anitha George A. Tsihrintzis- Internet of Medical Things Remote Healthcare Systems and Applications, covered by Scopus

Reference books:

1. Alasdair Gilchrist- Industry 4.0: The Industrial Internet of Things, 1st Ed., Apress, 2017
2. Reis, Catarina I., and Marisa da Silva Maximiano, eds.- Internet of Things and advanced application in healthcare, 1st Ed., IGI Global, 2016

e-Resources:

1. https://www.coursera.org/specializations/developing-industrial-iot#courses
2. https://www.coursera.org/learn/industrial-internet-of-things
3. https://www.coursera.org/learn/internet-of-things-sensing-actuation

IV-Year-I Semester	Programming and Interfacing with Microcontrollers (Professional Elective-3)	L	T	P	C
PE4101		3	0	0	3

Course objectives:

The main objectives are

1. To understand advanced and emerging networking technologies
2. To obtain skills to do advanced networking research and programming
3. To learn how to use software programs to perform varying and complex networking tasks
4. To expand upon the knowledge learned and apply it to solve real world problems

Unit–1: (10 hrs)

INTRODUCTION: Introduction – History - Creative Coding Platforms - Open-Source Platforms – PIC -Arduino, Sketch, Raspberry Pi, Iterative coding methodology – Python Programming -Mobile phones and similar devices - Arm Devices - Getting used to Arduino – Sensor Characterization: Safety, Basic Electronics (circuit theory, measurements, parts identification) Sensors and Software: Understanding Processing Code Structure, variables and flow control, Interfacing to the Real World.

Unit–2: (9 hrs)

SOFTWARE FRAMEWORKS: Software: open Frameworks as our IDE (C/C++) - "Arduino" Language (C/C++) -Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem Representing "reality" with computers. Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) - Digital to Analog Conversion(DAC) – Microcontrollers

Unit–3: (9 hrs)

HARDWARE COMMUNICATION: Communication – Serial& Parallel - Hardware to Hardware Communication - I2C/IIC(Inter-Integrated Circuit) - SPI (Serial Peripheral Interface) – Serial UART Communication - Introduction to the command line – git/GitHub. Introduction to Programming: A comparative studio between Arduino + open Frameworks–Arduino compatible Microcontrollers Sensors and Actuators.

Unit–4: (10 hrs)

ADVANCED I/O INTERFACING: Advanced I/O – open Frameworks: Live Network feeds (push and pull) – Data persistence(saving data and preferences) - Database interface (MySQL, SQLite, XML, PHP/Web) -Arduino: Wired/Wireless Networking

Unit–5: (10 hrs)

IoT, FUTURE AND PERSPECTIVES: Talking to the cloud: Baby steps to

Internet of Things, TCP/IP and UDP - Building peer to peer communication system using Bluetooth &Wi-Fi– Experiments.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Assess and solve basic binary math operations using the microprocessor and explain the microprocessors and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.

CO2 Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.

CO3 Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller

CO4 Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.

CO5 Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.

Text books:

1. Programming Interactivity, Second Edition By Josha Noble, 2012
2. Programming the Raspberry Pi: Getting Started with Python 2E, 2016

Reference books:

1. Ramesh Gaonkar. Microprocessor Architecture, Programming and Applications with 8085, 5th Edition, PIP Publication
2. Microprocessors and Microcontrollers, S K Mandal. WBUT Series by TMH.

IV-Year-I Semester	Deep Learning (Professional Elective-3)	L	T	P	C
PE4101		3	0	0	3

Course objectives:
The main objectives are
1. To understand basic concepts of neural networks.
2. To emphasize learning and optimization techniques.
3. To learn CNN, and its variant models for CV.
4. To learn effective training methods to solve real-world problems.
5. To learn RNN, and its variant models for NLP.

Unit–1: (10 hrs)
Deep learning basics: Introduction, the perceptron, Overfitting and generalization, linear perceptron, learning XOR function with non-linear functions, feedforward neural networks, types of activation functions, types of loss functions, Back-Propagation.
Unit–2: (9 hrs)
Optimization: Challenges in neural network optimization, Regularization, Gradient Descent, Stochastic Gradient Descent, Momentum Optimizer, AdaGrad, RMSProp, Adam, Batch normalization.
Unit–3: (9 hrs)
Deep Learning for Computer Vision: Building blocks of CNN, Local receptive fields, Shared weights and bias, stride, Pooling layers, Max-pooling, Average pooling, CNN for image classification – AlexNet, VGG, GoogleNet, ResNet architectures. CNN for segmentation – Unet.
Unit–4: (10 hrs)
Effective training of Deep Neural Networks: Early stopping, Dropout, Instance Normalization, Group Normalization, Transfer Learning, Data Augmentation.
Unit–5: (10 hrs)
Deep Learning for Natural Language Processing: Computational representation of language, one-hot representation of words, word vectors – the skip-gram word2vec model, The CBOW word2vec model, word vector arithmetic, RNN, LSTM.

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Demonstrate the building of fully connected feedforward neural networks
CO2 Perform optimized training of the feedforward neural networks
CO3 Design convolutional neural networks for solving basic computer vision problems

CO4 Apply effective training techniques
CO5 Design RNNs for NLP

Text books:

1. Deep Learning- Ian Goodfellow, Yoshua Benjio, Aaron Courville, The MIT Press
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition - Aurélien Géron, O'Reilly Media, Inc. ISBN: 9781492032649
3. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc

Reference books:

1. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.
2. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
3. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
4. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.
5. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009

e-Resources:
1. NPTEL Lecture material - Lecture Series on Deep Learning by Prof. P. K. Biswas, Department of Electrical & Electronic Communication Engineering, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc22_cs22/preview#:~:text=Week%201%3A%20Introduction%20to%20Deep,Multilayer%20Perceptron%2C%20Back%20Propagation%20Learning

IV-Year-I Semester	Mobile Computing (Professional Elective-3)	L	T	P	C
PE4101		3	0	0	3

Course objectives:

The main objectives are

1. To study the emerging technologies in the context of wireless networks.
2. To understand the mobile computing environment
3. To learn about pervasive computing environment

Unit–1: (10 hrs)

Mobile Communications: An Overview- Mobile Communication-guided transmission, unguided transmission- signal propagation frequencies, antennae, modulation, modulation methods and standards for voice-oriented data communication standards, modulation methods and standards for data and voice communication, mobile computing- novel applications and limitations, mobile computing architecture, mobile system networks. Mobile devices and systems: Cellular networks and frequency reuse, Mobile smart phones, Smart mobiles and systems, handheld pocket computers, Hand held devices, Smart systems, Limitations of mobile devices.

Unit–2: (9 hrs)

GSM and other 2G Architectures: GSM-services and system architecture, Radio interfaces of GSM, Protocols of GSM, Localization, Call handling, GPRS system architecture. Wireless medium access control, CDMA, 3G, 4G and 5G Communication: Modulation, Multiplexing, Controlling the medium access, spread spectrum, Coding methods, IMT-20003G wireless communication standards, WCDMA 3G communication standards, CDMA 3G communication standards, Broadband wireless access, 4G networks, 5G Networks.

Unit–3: (9 hrs)

Mobile IP Network layer: IP and Mobile IP network layers: OSI layer functions, TCP/IP and Internet protocol, Mobile internet protocol; Packet delivery and Handover Management; Location Management: Agent Discovery; Mobile TCP Introduction to Mobile Ad-hoc network: fixed infrastructure architecture, MANET infrastructure architecture; MANET: properties, spectrum, applications; Security in Ad-hoc network; Wireless sensor networks; sensor network applications.

Unit–4: (10 hrs)

Synchronization: Synchronization in mobile computing systems, Usage models for Synchronization in mobile application, Domain-dependant specific rules for data synchronization, Personal information manager, synchronization and conflict resolution strategies, synchronizer; Mobile agent: mobile agent design, aglets; Application Server.

Unit–5: (10 hrs)
Mobile Wireless Short Range Networks and Mobile Internet: Wireless networking and wireless LAN, Wireless LAN (WLAN) architecture, IEEE 802.11protocol layers, Wireless application protocol (WAP)- WAP1.1 architecture, wireless datagram protocol (WDP), Wireless Transport Layer Security (WTLS), wireless transaction and session layers, wireless application environment.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Interpret Wireless local area networks (WLAN): MAC design principles, 802.11 WIFI

CO2 Discuss fundamental challenges in mobile communications and potential Techniques in GSM

CO3 Demonstrate Mobile IP in Network layer

CO4 Elaborate TCP/IP Protocols and database issues and illustrate different data delivery methods and synchronization protocols

CO5 Develop applications that are mobile-device specific and demonstrate current Practice in mobile computing contexts

Text books:

1. Mobile Computing, 2nd edition, Raj kamal, Oxford,2011
2. Mobile Computing, Technology Applications and Service Creation, 2nd Edition, Asoke K Talukder, Hasanahmed, Roopa R Yavagal, McGraw Hill,2017.

Reference books:

1. “Principles of Mobile Computing,” 2nd Edition, UWE Hansmann, LotherMerk, Martin S. Nocklous, Thomas Stober, Springer.2003

IV-Year-I Semester	Privacy and Security in IoT (Professional Elective-3)	L	T	P	C
PE4101		3	0	0	3

Course objectives:

The main objectives are

1. Ability to understand the Security requirements in IoT.
2. Understand the cryptographic fundamentals for IoT
3. Ability to understand the authentication credentials and access control
4. Understand the various types Trust models and Cloud Security

Unit–1: (10 hrs)

INTRODUCTION: SECURING THE INTERNET OF THINGS: Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT – Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

Unit–2: (9 hrs)

CRYPTOGRAPHIC FUNDAMENTALS FOR IOT: Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

Unit–3: (9 hrs)

IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT: Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control.

Unit–4: (10 hrs)

PRIVACY PRESERVATION AND TRUST MODELS FOR IOT: Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access.

Unit–5: (10 hrs)

CLOUD SECURITY FOR IOT: Cloud services and IoT – offerings related to IoT from cloud service providers – CloudIoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Apply Security and privacy concepts in IoT devices
CO2 Gain knowledge on types of Vulnerabilities
CO3 Familiar with Encryption & Decryption algorithms

Text books:

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations.

Reference books:

1. Securing the Internet of Things Elsevier

IV-Year-I Semester	Applications of IoT in Robotics (Professional Elective-4)	L	T	P	C
PE4102		3	0	0	3

Course objectives:

The main objectives are

1. To learn basics of Internet of Things (IoT), and its execution using multiple robotic sensors.
2. To understand Internet of Robotic Things (IoRT) and its various implementations in industry and automation.
3. To implement IoT and Robotics application in autonomous driving and health care.

Unit–1: (10 hrs)

Introduction to IoT and Vision systems:

History and evolution of IoT, AI, ML, Machine Vision, optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms and vision systems.

Unit–2: (9 hrs)

Robotic Sensors: Optical sensors and actuators; Mechanical sensors and actuators; Acoustic sensors and actuators; Performance characteristics of sensors and actuators

Unit–3: (9 hrs)

Internet of Robotic Things: Communication architecture for IoRT; Decentralized and automated IoT infrastructure using Blockchain; IoRT Platforms Architecture, IoRT applications

Unit–4: (10 hrs)

Autonomous Vehicle Systems:

Introduction to Autonomous Driving; Perception in Autonomous Driving; Robot Operating System (ROS) Overview - Client Systems for Autonomous Driving - Decision planning and control in autonomous vehicle systems - Cloud Platform for Autonomous Driving.

Industrial Internet of Things: IIoT Architecture; IIoT Applications and Challenges; IIoT Standards and Frameworks; IIoT security concerns.

Unit–5: (10 hrs)

IoMT and Robotics in Healthcare: IoMT Driven connected healthcare, Efficient design for IoMT based healthcare design, Robotics in healthcare.

Cloud Robotics and Industrial Automation: Components of Cloud Robotics; Limitations and challenges of Cloud Robotics; Applications: Autonomous mobile robots, Cloud medical robots, Industrial robots

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand IoT ecosystem in robotic paradigm
CO2 Analyze IoT infrastructure and develop IoRT applications
CO3 Apply IoT in robotics over different platforms
CO4 Implement Cloud robotics in automations
CO5 Implement automated applications using multiple robotic sensors

Text books:

1. Vermesan, Ovidiu, and Joël Bacquet, eds.,Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution, 1st edition, River Publishers, 2017.
2. A.K.Gupta, S.K.Arora, and J.Riescher, Industrial Automation and Robotics, 1st edition, Mercury Learning and Information LLC,2017

Reference books:

1. A.K Dubey, A.Kumar, and S.R Kumar., AI and IoT-based Intelligent Automation in Robotics, 1st edition. Wiley, 2020
2. A.E.Hassanien, N.Dey, and S.Borra, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition ,Taylor & Francis Group,2019
3. S.Liu, L.Li and J.Tang, Creating Autonomous Vehicle Systems, Synthesis Lectures on Computer Science, 1st edition ,Morgan & Claypool,2018
4. Nathan Ida, Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, 2nd edition The Institution of Engineering and Technology, 2017.

IV-Year-I Semester	No SQL Databases (Professional Elective-4)	L	T	P	C
PE4102		3	0	0	3

Course objectives:
The main objectives are
1. To make student understand about NoSQL, its characteristics and history, and the primary benefits for using NoSQL data
2. To explore students about various types of NO-SQL databases (wide-column, document, key-value, graph and object-oriented) in adding content and running queries
3. To make students in understanding the NoSQL data architecture patterns

Unit–1: (8 hrs)
Introduction to No-SQL: What is No-SQL? NoSQL Overview, NoSQL Database Environment, NoSQL Options, when to use No-SQL? Introduction to No-SQL development.
Unit–2: (10 hrs)
Column-Oriented Databases: Column family, key and key space, Apache HBASE
Unit–3: (10 hrs)
Key Value Databases: What is key value store? Key value databases, Dynamo DB.
Unit–4: (10 hrs)
Document based Databases: What is document? Document Databases, Mango DB.
Unit–5: (10 hrs)
Graph Databases: What is Graph Database? Graph Databases, Neo4J.

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Outlines the importance of NoSQL and types of NoSQL Databases.
CO2 Demonstrates the working environment of Column-oriented databases.
CO3 Demonstrates the working environment of Key Value Databases.
CO4 Demonstrates the working environment of Document based Databases.
CO5 Demonstrates the working environment of Graph Databases.

Text books:
1. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education
2. NoSQL Databases A Complete Guide - 2020 Edition, Author: Gerardus

Blo dyk, Publisher: 5starcooks

Reference books:

1. Redmond, E. &Wilson, Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition.
2. NoSQL For Dummies, Author: Adam Fowler, Publisher: A wiley Brand

e-Resources

1. https://www.guru99.com/hbase-tutorials.html
2. https://docs.mongodb.com/manual/tutorial/
3. https://dynobase.dev/dynamodb/
4. https://neo4j.com/developer/graph-db-vs-nosql

IV-Year-I Semester	Mean Stack Technologies (Professional Elective-4)	L	T	P	C
PE4102		3	0	0	3

Course objectives:

The main objectives are

1. To explore all the full stack development tools with respect to MEAN.
2. To be able to build applications with contemporary technologies

Unit–1: (10 hrs)

HTML 5: Introduction to Web, Overview of Web Technologies, HTML - Introduction, DOCTYPE Declaration, Types of Elements, HTML Elements - Attributes, Metadata Element, Division and Span Elements, List Element, Link Element, Character Entities, HTML5 Global Attributes, Creating Table - Colspan/ Rowspan Attributes, border, cellspacing and cellpadding attributes, Creating Form Elements, Input Elements - Attributes, Color and Date Pickers.

JavaScript: Java script elements, let, statements, control statements, functions, Arrays and methods, Strings.

Unit–2: (9 hrs)

Java script ES features – let, var and const, destructuring, spread and rest operators, higher order functions, modules, classes and objects. Introduction to Asynchronous Programming, Callbacks, Promises, Async and Await, Executing Network Requests using Fetch API, Creating and consuming Modules.

Node.js: Why and What Node.js, How to use Node.js, Create a web server in Node.js, Node Package Manager, Modular programming in Node.js, Restarting Node Application, File Operations.

Unit–3: (9 hrs)

Express.js: Express Development Environment, defining a route, Handling Routes, Route and Query Parameters, How Middleware works, Chaining of Middleware, Types of Middleware, connecting to MongoDB with Mongoose, Validation Types and Defaults, Models, CRUD Operations, API Development, Why Session management, Cookies, Sessions, Why and What Security, Helmet Middleware, Using a Template Engine Middleware, Stylus CSS Pre-processor.

Typescript: Installing TypeScript, Basics of TypeScript, Function, Parameter Types and Return Types, Arrow Function, Function Types, Optional and Default Parameters, Rest Parameter, Creating an Interface, Duck Typing, Function Types, Extending Interfaces, Classes, Constructor, Access Modifiers, Properties and Methods, Creating and using Namespaces, Creating and using Modules, Module Formats and Loaders, Module Vs Namespace, What is Generics, What are Type Parameters, Generic Functions, Generic Constraints..

Unit–4: (10 hrs)

MongoDB: Introduction Module Overview, Document Database Overview, Understanding JSON, MongoDB Structure and Architecture, MongoDB Remote Management, Installing MongoDB on the local computer (Mac or Windows), Introduction to MongoDB Cloud, Create MongoDB Atlas Cluster, GUI tools Overview, Install and Configure MongoDB Compass, Introduction to the MongoDB Shell, MongoDB Shell JavaScript Engine, MongoDB Shell JavaScript Syntax, Introduction to the MongoDB Data Types, Introduction to the CRUD Operations on documents, Create and Delete Databases and Collections, Introduction to MongoDB Queries.

Unit–5: (10 hrs)

Angular JS: What is Angular, Features of Angular, Angular Application Setup, Components and Modules, Executing Angular Application, Elements of Template, Change Detection, Structural Directives - ngIf, ngFor, ngSwitch, Custom Structural Directive, Attribute Directives - ngStyle, ngClass, Custom Attribute Directive, Property Binding, Attribute Binding, Style and Event Binding, Built in Pipes, Passing Parameters to Pipes, Nested Components Basics, Passing data from Container Component to Child Component, Passing data from Child Component to ContainerComponent, Shadow DOM, Component Life Cycle, Template Driven Forms, Model Driven Forms or Reactive Forms, Custom Validators in Reactive Forms, Custom Validators in Template Driven forms, Dependency Injection, Services Basics, RxJS Observables, Server Communication using HttpClient, Communicating with different backend services using Angular HttpClient, Routing Basics, Router Links, Route Guards, Asynchronous Routing, Nested Routes.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Build client-side web pages
CO2 Summarize Java script ES6 features and Node JS components
CO3 Use Express.js for server-side Node JS components & type script
CO4 Use document database using MongoDB
CO5 Utilize Angular JS to design dynamic and responsive web pages

Text books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson.
2. Full Stack JavaScript Development with MEAN, Colin J Ihrig, Adam Bretz, 1st edition, SitePoint, SitePoint Pty. Ltd., O'Reilly Media.
3. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow,O'Reilly.

Reference books:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book,1st Edition, Dream Tech
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda SKatila, Cengage Learning.Software Project Management, Joel Henry, Pearson Education

IV-Year-I Semester	Wearable Computing (Professional Elective-4)	L	T	P	C
PE4102		3	0	0	3

Course objectives:

The main objectives are

1. Understand advanced and emerging technologies.
2. Obtain skills to do advanced research and programming
3. Learn how to use software programs to perform varying and complex tasks
4. Expand upon the knowledge learned and apply it to solve real world problems

Unit–1: (10 hrs)

INTRODUCTION: Introduction – History - Creative Coding Platforms - Open-Source Platforms – PIC - Arduino, Sketch, Raspberry Pi, Iterative coding methodology – Python Programming - Mobile phones and similar devices - Arm Devices - Basic Electronics (circuit theory, measurements, parts identification) Sensors and Software: Understanding Processing Code Structure, variables and flow control, Interfacing to the Real World

Unit–2: (9 hrs)

SOFTWARE HARDWARE FRAMEWORKS: Software: open Frameworks as our IDE (C/C++) - "Arduino" Language (C/C++) - Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem Representing "reality" with computers. Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) - Digital to Analog Conversion(DAC)– Microcontrollers - Communication – Serial& Parallel - Hardware to Hardware Communication - I2C/IIC (Inter-Integrated Circuit) - SPI (Serial Peripheral Interface) – Serial UART Communication

Unit–3: (9 hrs)

CYBERNETICS AND HUMANISTIC INTELLIGENCE: Wearables - Augmented Reality – Mixed Reality. Case studies, Oculus Rift (2012, 2013), AR versus VR - IoT and Wearables: Smart Cites and Wearable Computing as a form of urban design - Advanced I/O – open Frameworks: Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, SQLite, XML, PHP/Web) - Arduino: Wired/Wireless Networking (hardware vs. USB proxy) - Software serial (RS-232) talking to other devices - Advanced sensor/device communication SPI - Advance IC interfacing / Bit banging (bitwise operators) - Linux – GPIO.

Unit–4: (10 hrs)

THE WORLD OF THE FUTURE – INTERNET OF EVERYTHING: Humanistic Intelligence, Mann 1998. Wearable Computing and IoT (Internet of Things) The scale space theory; sur/sousveillance; integrity; Veillance Contract; Humanistic

Intelligence; Mediality Axis? Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Free-roaming AR: Wearable Computing, Wireless, Sensing, and Meta sensing with light bulbs Phenomenal Augmented Reality: Real world physical phenomena as the fundamental basis of mobile and wearable AR.

Unit–5: (10 hrs)

FUTURE AND PERSPECTIVES: Internet of Everything – The Future and perspectives – Challenges.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand advanced and emerging technologies
CO2 Extend the knowledge achieved and apply it to solve real world problems
CO3 Ability to analyse ethical issues related to the Wearable devices.
CO4 To contribute innovative thinking and innovation processes
CO5 Ability to integrate several domains through wearable technology

Text books:

1. "Practical Electronics for Inventors, Third Edition," by Paul Scherzand Simon Monk. 2016
2. Intel Galileo and Intel Galileo Gen 2API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)
3. Fundamentals of Wearable Computers and Augmented Reality, Second Edition by Woodrow Bar field 2015

Reference books:

1. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design By OmeshTickoo, Ravi Iyer 2016
2. Programming Interactivity, Second Edition By Josha Noble, 2012
3. Programming the Raspberry Pi: Getting Started with Python 2E, 2016Software Project Management, Bob Hughes & Mike Cotterell, TATA Mcgraw-Hill

IV-Year-I Semester	Big Data Analytics	L	T	P	C
PE4102	(Professional Elective-4)	3	0	0	3

Course objectives:
The main objectives are
1. To learn the concepts of big data analytics
2. To learn the concepts about Internet of things
3. To understand and implement smart systems

Unit–1: (10 hrs)
Introduction to Big Data and Hadoop:
Introduction to Big Data:
Big Data-definition, Characteristics of Big Data (Volume, Variety, Velocity), Data in the Warehouse and Data in Hadoop, why is Big Data Important? Patterns for Big Data Development, Examples of Big Data Analytics.
Introduction to Hadoop:
Working with Big Data: Google File System, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases, Hadoop Installation Modes.
Hadoop Distributed File System:
HDFS, Building Blocks of Hadoop (Name node, Data node, Secondary Name node, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo distributed mode, Fully Distributed mode), Configuring XML files.
Unit–2: (9 hrs)
Map Reduce: Introduction, How MapReduce works? MR Execution Flow with an Example, Understanding Hadoop API for MapReduce Framework (Old and New), Components of MapReduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner; MapReduce Programs for Word Count, Weather Dataset.
Unit–3: (9 hrs)
Hadoop IO: The Writable Interface, Writable Comparable and Comparators, Writable Classes: Writable wrappers for Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections, implementing a Custom Writable: Implementing a Raw Comparator for speed, Custom Comparators
Unit–4: (10 hrs)
PIG: Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Installation and Running of Pig, Execution Types, Evaluating Local and Distributed Modes, Pig Latin Editors, Comparison with databases, Pig Latin, Functions, Data Processing Operators, Checking out the Pig Script Interfaces,

Scripting with Pig Latin, Running Pig Programs.

Unit–5: (10 hrs)

Hive: Installing Hive, Comparison with Traditional Databases, Running Hive, Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analysing Data.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the Big Data Concepts and Big Data Technologies
CO2 Provide an overview of Apache Hadoop
CO3 Provide HDFS Concepts and Interfacing with HDFS
CO4 Understand Map Reduce Jobs
CO5 Provide hands on Hadoop Eco System (HDFS, MapReduce, Pig & Hive)

Text books:

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC.
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly.
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss.

Reference books:

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne

e-Resources:

1. Hadoop: http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Pig Latin: http://pig.apache.org/docs/r0.7.0/tutorial.html

IV-Year-I Semester	Cognitive IoT (Professional Elective-5)	L	T	P	C
PE4103		3	0	0	3

Course objectives:
The main objectives are
1. To emphasis the students from shifting their mindset from theoretical to practical multi-disciplinary skills through installing the know-how of actual practice in industry field
2. Impart the knowledge to log the sensor data and to perform further data analytics
3. Make the students to apply Internet of Things (IoT) data for business solution in various domain in secured manner

Unit–1: (10 hrs)
Cognitive IoT – Introduction: Cognitive IoT, Need for Cognitive IoT, Current and Future trends of IoT, Cognitive computing and applications.
Data Analytics of Cognitive IoT: Data Analytics for IoT Regression, Data Analytics for IoT ANN Classification, Data Analytics for IoT Modern DNN's.
Unit–2: (9 hrs)
Cloud and Edge Computing in IoT: Decentralized Computing, Cloud computing, Cloudlets and fog computing, Cloud and edge computing for large scale IoT applications.
Unit–3: (9 hrs)
Introduction to GPU: Introduction to GPU's Parallel programming for GPU, Parallel programming in CUDA, CNN Inference in GPU, CNN Training in GPU.
FPGA for Internet of Things: Benefits of FPGA, Interfacing FPGAs with IoT-based edge devices, IoT-FPGA based applications, Microsemi's SmartFusion2 SoC FPGA
Unit–4: (10 hrs)
IoT Enabling Technologies and Devices: Big data, Digital twin, Cloud Computing, Sensors, Communications, Analytical software, Edge Devices.
Unit–5: (10 hrs)
Security in Cognitive IoT: Security in Cognitive IoT, Security Issues in IoT, A hardware assisted approach for security, Architectural level overview for providing security, Security threats.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Integrate the aspects of human cognitive processes in the system design
CO2 Comprehend the underlying cognitive process can have many abstractions of a cognitive cycle such as 'Sense', 'Understand', 'Decide'

and ‘Act’

CO3 Detect any failures of system components and re-configure itself which provides a graceful degradation through self-healing

CO4 Incorporate recent advancements in the machine learning including deep learning in IOT

CO5 Analyze security issues in IoT applications

Text books:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange and Stefan Meissner, Enabling things to talk –Designing IoT solutions with the IoT Architecture Reference Model, 1st edition ,Springer Open, 2016
2. Matin, Mohammad Abdul, ed. Towards Cognitive IoT Networks, 1st edition ,Springer International Publishing, 2020.

Reference books:

1. Arshdeep Bahga and Vijay Madisetti, Cloud Computing: A Hands-on Approach, 1st edition, CreateSpace Independent Publishing Platform, 2013.
2. John Mutumba Bilay, Peter Gutsche, Mandy Krimmel and Volker Stiehl, SAP Cloud Platform Integration: The Comprehensive Guide, 2nd edition, Rheinwerg publishing.2019.
3. Mahalle, Parikshit Narendra, and Poonam N. Railkar, Identity management for internet of things, 1st edition , River Publishers, 2015.

IV-Year-I Semester	Data Science, Preparation and Analysis (Professional Elective-5)	L	T	P	C
PE4103		3	0	0	3

Course objectives:
The main objectives are
1. To gain knowledge in the basic concepts of Data Analysis
2. To acquire skills in data preparatory and pre-processing steps
3. To learn the tools and packages in Python for data science
4. To gain understanding in classification and Regression Model
5. To acquire knowledge in data interpretation and visualization techniques

Unit–1: (10 hrs)
Introduction: Need for data science – benefits and uses – facets of data – data science process – setting their search goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.
Unit–2: (9 hrs)
Describing Data I: Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs –averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – inter quartile range – variability for qualitative and ranked data.
Unit–3: (9 hrs)
Python for Data Handling: Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets –aggregation and grouping – pivot tables.
Unit–4: (10 hrs)
Describing Data II: Normal distributions – z scores – normal curve problems– finding proportions – finding scores –more about z scores – correlation – scatter plots – correlation coefficient for quantitative data –computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2– multiple regression equations –regression toward the mean.
Unit–5: (10 hrs)
Python for Data Visualization: Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms,

binnings, and density – three-dimensional plotting – geographic data – data analysis using state models and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Gain knowledge in the basic concepts of Data Analysis
CO2 Acquire skills in data preparatory and preprocessing steps
CO3 Learn the tools and packages in Python for data science
CO4 Gain understanding in classification and Regression Model
CO5 Acquire knowledge in data interpretation and visualization techniques

Text books:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Chapters 1–7 for Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O‟Reilly, 2016. (Chapters 2– 4 for Units IV and V)

Reference books:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

IV-Year-I Semester	DevOps	L	T	P	C
PE4103	(Professional Elective-5)	3	0	0	3

Course objectives:
The main objective is to improv collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.

Unit–1: (10 hrs)
Phases of Software Development life cycle. Values and principles of agile software development.
Unit–2: (9 hrs)
Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, Dev Ops delivery pipeline, Dev Ops eco system
Unit–3: (9 hrs)
Dev Ops adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.
Unit–4: (10 hrs)
CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment , Benefits of CI/CD, Metrics to track CICD practices.
Unit–5: (10 hrs)
Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity model, DevOps maturity Assessment.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
CO2 Describe Dev Ops & Dev Sec Ops methodologies and their key concepts
CO3 Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
CO4 Set up complete private infrastructure using version control systems and CI/CD tools

Text books:

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim, John Willis, Patrick Debois, Jez Humb,1st Edition, O'Reilly publications, 2016.
2. What is Devops? Infrastructure as code, 1st Edition, Mike Loukides ,O'Reilly publications, 2012

Reference books:

1. Building a DevOps Culture, 1st Edition, Mandi Walls, O'Reilly publications, 2013.
2. The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices, 1st Edition, Viktor Farcic, CreateSpace Independent Publishing Platform publications, 2016
3. Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation, 1st Edition, Jez Humble and David Farley, 2010.
4. Achieving DevOps: A Novel About Delivering the Best of Agile, DevOps, and microservices, 1st Edition, Dave Harrison, Knox Lively, Apress publications, 2019

IV-Year-I Semester	Human Computer Interaction (Professional Elective-5)	L	T	P	C
PE4103		3	0	0	3

Course objectives:

The main objectives are

1. To learn the foundations of Human Computer Interaction
2. To become familiar with the design technologies for individuals and persons with disabilities
3. To be aware of mobile HCI.
4. To learn the guidelines for user interface.

Unit–1: (10 hrs)

FOUNDATIONS OF HCI: The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies

Unit–2: (9 hrs)

DESIGN & SOFTWARE PROCESS: Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

Unit–3: (9 hrs)

MODELS AND THEORIES: HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

Unit–4: (10 hrs)

MOBILE HCI: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

Unit–5: (10 hrs)

WEB INTERFACE DESIGN: Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Design effective dialog for HCI

CO2 Design effective HCI for individuals and persons with disabilities.

CO3 Assess the importance of user feedback

CO4 Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites

CO5 Develop meaningful user interface

Text books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human Computer Interaction‖, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2. Brian Fling, ―Mobile Design and Development‖, First Edition, O‘Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, ―Designing Web Interfaces‖, First Edition, O‘Reilly, 2009. (UNIT-V)

Reference books:

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia
2. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
3. Human –Computer Interaction, Smith - Atakan, Cengage Learning

IV-Year-I Semester	NPTEL/SWAYAM	L	T	P	C
PE4103	(Professional Elective-5)	3	0	0	3

- A candidate shall complete at least one MOOC course as Professional Elective course – 2 or 5 of 12 weeks duration.
- Enrolment of MOOC course will be initiated from the date of commencement of classwork for Second Year – 2nd Semester.
- MOOC course completion certificate must be submitted on or before the completion of Fourth Year – 1st Semester to consider it for Regular evaluation. Otherwise, it will be considered as Supplementary.
- Student must pursue and acquire a certificate for a MOOC course only from the SWAYAM/NPTEL through online with the approval of Head of the Department concerned in order to earn the 3 credits.
- List of courses will be announced by the respective Board of Studies at the time of commencement of class work for Second Year – 2nd Semester.

IV-Year-I Semester	Cyber Forensics	L	T	P	C
OE4101	(Open Elective-3)	3	0	0	3

Course objectives:
The main objectives are
1. To understand the cyberspace.
2. To understand the forensics fundamentals.
3. To understand the evidence capturing process.
4. To understand the preservation of digital evidence.

Unit–1: (10 hrs)
Computer Forensics Fundamentals: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources / Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence? Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement Computer Forensic Technology, Types of Business Computer Forensics Technology.
Unit–2: (9 hrs)
Computer Forensics Evidence and Capture: Data Recovery: Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Case Histories. Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collecting and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody
Unit–3: (9 hrs)
Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence. Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Considerations, Practical Implementation.
Unit–4: (10 hrs)
Computer Forensics Analysis: Discovery of Electronic Evidence: Electronic Document Discovery: A Powerful New Litigation Tool, Identification of Data: Timekeeping, Time Matters, Forensic Identification and Analysis of Technical Surveillance Devices. Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files. Networks: Network Forensics Scenario, A Technical Approach, Destruction of Email, Damaging Computer Evidence, International Principles Against

Damaging of Computer Evidence, Tools Needed for Intrusion Response to the Destruction of Data, Incident Reporting and Contact Forms.

Unit–5: (10 hrs)

Current Computer Forensics Tools: Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Summarize the forensic fundamentals
CO2 Explore Forensic Evidences
CO3 Summarize methods to preserve the digital evidences
CO4 Analyze digital forensics

Text books:

1. "Computer Forensics: Computer Crime Scene Investigation", JOHN R. VACCA, Firewall Media.
2. "Guide to Computer Forensics and Investigations" 4e, Nelson, Phillips Enfinger, Steuart, Cengage Learning.

Reference books:

1. "Computer Forensics and Cyber Crime", Marjie T Britz, Pearson Education.
2. "Computer Forensics", David Cowen, Mc Graw Hill.
3. Brian Carrier, "File System Forensic Analysis", Addison Wesley, 2005

IV-Year-I Semester	Disaster Management (Open Elective-3)	L	T	P	C
OE4101		3	0	0	3

Course objectives:
The main objectives is to provide different disasters, tools and methods for disaster management are

Unit–1: (10 hrs)
Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

Unit–2: (9 hrs)
Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

Unit–3: (9 hrs)
Capacity Building: Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels.

Unit–4: (10 hrs)
Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management.

Unit–5: (10 hrs)
Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans..

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understanding Disasters, man-made Hazards and Vulnerabilities
CO2 Understanding disaster management mechanism
CO3 Understanding capacity building concepts
CO4 Understanding coping Strategies

CO5 Understanding planning of disaster managements

Text books:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

Reference books:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

IV-Year-I Semester	Logistics and Supply Chain Management (Open Elective-3)	L	T	P	C
OE4101		3	0	0	3

Course objectives:
The main objective is to understand the importance of Supply chain management in present Business context.

Unit–1: (10 hrs)
Logistics and Competitive strategy: Competitive advantage – Gaining Competitive advantage through logistics-Integrated supply chains– Competitive performance - Models in Logistics Management - Logistics to Supply Chain Management – Focus areas in Supply Chain Management Customer service and retention- Basic service capability Value added services

Unit–2: (9 hrs)
Measuring logistics costs and Performance: The concept of Total Cost analysis – Principles of logistics costing – Logistics and the bottom-line – Impact of Logistics on shareholder value - customer profitability analysis – direct product profitability – cost drivers and activity-based costing.

Unit–3: (9 hrs)
Logistics and Supply chain relationships: Benchmarking the logistics process and SCM operations –Mapping the supply chain processes – Supplier and distributor benchmarking –setting benchmarking priorities – identifying logistics performance indicators –Channel structure – Economics of distribution –channel relationships –logistics service alliances.

Unit–4: (10 hrs)
Sourcing, Transporting and Pricing Products: Sourcing decisions and transportation in supply chain – infrastructure suppliers of transport services – transportation economics and pricing – documentation - pricing and revenue management Lack of coordination and Bullwhip Effect - Impact of lack of coordination. - CRM – Internal supply chain management.

Unit–5: (10 hrs)
Managing Global Logistics and global Supply Chains: Logistics in a global economy – views of global logistics- global operating levels – interlinked global economy – The global supply chains -Global supply chain business processes – Global strategy – Global purchasing – Global logistics – Channels in Global logistics – Global alliances – Issues and Challenges in Global Supply Chain Management.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Growing importance of Logistics and Supply Chain Management
CO2 LSCM Costs and Performance
CO3 Benchmarking in SCM
CO4 Sourcing and transportation
CO5 Global aspects in SCM

Text books:

1. Donald J. Bowersox and David J.Closs: "Logistical Management" The Integrated Supply Chain Process, TMH, 2011.
2. Edward J Bradi, John J Coyle: "A Logistics Approach to Supply Chain Management, Cengage Learning, New Delhi, 2012.
3. Sunil Chopra and Peter Meindl: "Supply chain Management: Strategy, Planning and Operation", Pearson Education, New Delhi 2013

Reference books:

1. Rahul V Altekar: Supply Chain Management, PHI Learning Ltd, New Delhi, 2009
2. Deepak P, Milind M.Oka: "Supply Chain Management" Everest Publishing House, New Delhi

IV-Year-I Semester	Cyber Security Essentials		L	T	P	C
OE4101	(Open Elective-3)		3	0	0	3

Course objectives:

The main objectives are

1. To learn the foundations of Cyber security and threat landscape.
2. To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.

Unit–1: (10 hrs)

Introduction to Cyber security: Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues, and challenges of cyber security

Unit–2: (9 hrs)

Cyber-crime and Cyber law: Classification of cyber-crimes, Common cyber-crimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber-crimes, Remedial and mitigation measures, Legal perspective of cyber-crime, IT Act 2000 and its amendments, Cyber-crime and offences, Organisations dealing with Cyber-crime and Cyber security in India, Case studies

Unit–3: (9 hrs)

Data Privacy and Data Security and Security Introduction to Social networks:

Data Privacy and Data Security: Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, big data security issues and challenges, Data protection regulations of other countries-General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., social media- data privacy and security issues

Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies

Unit–4: (10 hrs)
E - Commerce and Digital Payments
Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act, 2007.
Unit–5: (10 hrs)
Digital Devices Security, Tools, and Technologies for Cyber Security: End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the fundamental concepts of cyberspace, including its architecture, communication technologies, and the evolution of the internet

CO2 Comprehend various types of cybercrimes, analyse cybercriminals modus operandi, and discuss common cybercrimes targeting computers, mobiles, and vulnerable populations

CO3 Analyse the principles of data privacy and protection, evaluate data protection regulations such as GDPR and PIPEDA, and discuss compliance measures

CO4 Assess security issues, challenges the impact of social media on privacy and recommend security best practices. Students will also be equipped to advocate for responsible and secure social media usage

CO5 Articulate the e-commerce, evaluate its components, and analyze e-commerce security threats. Comprehend various digital payment modes, understand the risks associated with them, and propose preventive measures

Text books:

1. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther

Press. Edition 2010

2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)

Reference books:

1. CSX- cyber security fundamentals 2 nd edition, Published by ISACA, Cyber security, Network Security, Data Governance Security

IV-Year-I Semester	Cryptography and Network Security (Open Elective-4)	L	T	P	C
OE4102		3	0	0	3

Course objectives:
The main objectives are
1. To understand and classify various security attacks, services mechanisms and classical cryptographic techniques
2. To analyse the design principles of block ciphers and their implementation.
3. To compute and analyse asymmetric key cryptographic algorithms
4. To evaluate Authentication, Hash Codes and verify the digital signatures
5. To impart the knowledge on Network security concepts.

Unit–1: (10 hrs)
Introduction to Cryptography and Network Security: Introduction: Security attacks, services & mechanisms, Network Security Model, Symmetric Cipher Model, Mathematics of Cryptography, Substitution Ciphers, Transposition Ciphers Techniques, Steganography
Unit–2: (9 hrs)
Symmetric Key Cryptography: Mathematics of Symmetric Key Cryptography, Modern Block Ciphers, Modes of Block Ciphers, Design Principles of Block Ciphers, Feistel Cipher, Data Encryption Standard, Double DES, Triple DES, International Data Encryption Algorithm, CAST-128, Blowfish, Advanced Encryption Standard
Unit–3: (9 hrs)
Asymmetric (Public) Key Cryptography: Mathematics of Asymmetric Key Cryptography: Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Primitive Roots, Discrete Logarithms, Principles of Public Key Cryptosystems, Applications, RSA, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, El-Gammal Key Exchange.
Unit–4: (10 hrs)
Data Integrity, Digital Signatures, Authentication Protocols: Requirements of Hash Functions and Message Authentication Codes, Hash Algorithms: MD5, SHA-160,256,512, RIPEMD, Properties of Digital Signatures, DSS, Authentication Applications: Kerberos Version4 and Version 5.
Unit–5: (10 hrs)
Network Security: IP Security: IP Security Overview, Architecture, Authentication Header, Encapsulating Security Payload. **Web Security:** Overview, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction. **Email Security:** Pretty Good Privacy, S/MIME,
System Security: Intruders, Password Management, Viruses and Worms.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Classify various security attacks, services, mechanisms, and classical cryptographic techniques

CO2 Analyse the design principles of block ciphers and their implementation

CO3 Computes and Analyse various Asymmetric Key Cryptographic techniques

CO4 Evaluates Authentication, Hash Codes and verify the digital signatures

CO5 Impart the knowledge on Network security concepts

Text books:

1. Cryptography and Network Security Principles and Practices: William Stallings, Pearson Education, 5th Edition
2. Cryptography and Network Security, Behrouz A Forouzan, Tata McGraw Hill, 3rd Edition

Reference books:

1. Practical Cryptography, Bruce Schneier, Wiley, Deamtech India Pvt Ltd

IV-Year-I Semester	Blockchain Technologies (Open Elective-4)	L	T	P	C
OE4102		3	0	0	3

Course objectives:

The main objectives are

1. To understand various security attacks and methods to combat those attacks using various mathematical methods.
2. To understand the existing public key cryptographic systems and key management systems and applying them to real-time scenarios.
3. To introduce the fundamental concepts of blockchain and its significance in providing decentralized trust among distributed entities.
4. To familiarize student about the Ethereum blockchain technology and application development on the Ethereum platform.
5. To introduce various commercial and open blockchain networks and challenges associated with the design of applications in the blockchain.

Unit–1: (10 hrs)

Data Security Preliminaries: Introduction: Security attacks, services & mechanisms, Network Security Model, Symmetric Cipher Model, Mathematics of Cryptography, Substitution Ciphers, Transposition Ciphers Techniques, Steganography, Mathematics of Symmetric Key Cryptography, Data Encryption Standard, Double DES

Unit–2: (9 hrs)

Public Key Cryptosystems: Mathematics of Asymmetric Key Cryptography: Prime Numbers, Modular Arithmetic, Chinese Remainder Theorem, Primitive Roots, Discrete Logarithms, RSA, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Requirements of Hash Functions and Message Authentication Codes, Hash Algorithms: MD5, SHA-160,256,512, Authentication Applications: Kerberos Version4 and Version 5.

Unit–3: (9 hrs)

Introduction to Blockchain: Blockchain, Trust, Types of Blockchain, Blockchain implementation, Blockchain in practice, Technology use cases: Distributed storage, distributed computing, decentralized communications, financial service use cases

Unit–4: (10 hrs)

Application development on Ethereum Blockchain: Technology on Ethereum, Ethereum accounts, Ethereum work, decentralized applications, DAOs, Ethereum blockchain development, Smart Contracts: Life cycle, design, development and integration and validation.

Unit–5: (10 hrs)

Private Blockchain: Platforms: Categories of blockchain, private blockchain technology: Chain Core, Hydrachain, Hyperledger, Interbit, Multichain, Open chain, Quorum, Stellar, Challenges: Governance Challenges, Technical challenges.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the need for security and also acquires sufficient knowledge to build a secured information network

CO2 Apply the public key cryptography techniques to provide third-party security for the network-based applications.

CO3 To understand and apply the blockchain technology for providing decentralized, distributed and trust-worthy systems in real-time applications

CO4 Design and develop smart contracts which are useful in integrating resource-constrained networks (such as IoT) with blockchain

CO5 Understand various types of blockchain networks and their application scenarios

Text books:

1. Cryptography and Network Security Principles and Practices: William Stallings, Pearson Education, 5th Edition
2. Blockchain : A practical guide to developing business, law and technology solutions. J.J. Bambara, P. R. Allen – MGH Publishers

Reference books:

1. Cryptography and Network Security, Behrouz A Forouzan, Tata McGraw Hill, 3rd Edition
2. Practical Cryptography, Bruce Schneier, Wiley, Deamtech India Pvt Ltd.
3. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
4. Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018

e-Resources

1. https://crypto.stanford.edu/~dabo/courses/OnlineCrypto/
2. https://nptel.ac.in/courses/106105162.
3. https://www.udemy.com/course/build-your-blockchain-az/
4. https://archive.nptel.ac.in/courses/106/105/106105235/

IV-Year-I Semester	High Performance Computing (Open Elective-4)	L	T	P	C
OE4102		3	0	0	3

Course objectives:

The main objective is the design of advanced modern computing systems. In particular, the design of modern microprocessors, characteristics of the memory hierarchy, and issues involved in multi-threading and multi-processing are discussed. The main objective of this course is to provide students with an understanding and appreciation of the fundamental issues and trade-offs involved in the design and evaluation of modern computers

Unit–1: (10 hrs)

Introduction to Parallel hardware and software, need for high performance systems and Parallel Programming, SISD, SIMD, MISD, MIMD models, Performance issues

Unit–2: (9 hrs)

Processors, PThreads, Thread Creation, Passing arguments to Thread function, Simple matrix multiplication using Pthreads, critical sections, mutexes, semaphores, barriers and conditional variables, locks, thread safety, simple programming assignments.

Unit–3: (9 hrs)

Open MP Programming: introduction, reduction clause, parallel for-loop scheduling, atomic directive, critical sections and locks, private directive, Programming assignments, n body solvers using openMP.

Unit–4: (10 hrs)

Introduction to MPI programming: MPI primitives such as MPI_Send, MPI-Recv, MPI_Init, MPI-Finalize, etc., Application of MPI to Trepizoidal rule, Collective Communication primitives in MPI, MPI derived datatypes, Performance evaluation of MPI programs, Parallel sorting algorithms, Tree search solved using MPI, Programming Assignments.

Unit–5: (10 hrs)

Introduction to GPU computing, Graphics pipelines, GPGPU, Data Parallelism and CUDA C Programming, CUDA Threads Organization, Simple Matrix multiplication using CUDA, CUDA memories. Bench Marking and Tools for High Performance Computing Environments, Numerical Linear Algebra Routines BLAS for Parallel Systems evaluation

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the concepts and terminology of high-performance computing

CO2 Can write and analyze the behavior of high-performance parallel programs for distributed memory architectures (using MPI).

CO3 Can write and analyze the behavior of high-performance parallel programs for shared memory architectures (using Pthreads and OpenMP)

CO4 Can write simple programs for the GPU

CO5 Can independently study, learn about, and present some aspect of high-performance computing

Text books:

1. An Introduction to Parallel Programming, Peter S Pacheco, Elsevier, 2011
2. Programming Massively Parallel Processors, Kirk & Hwu, Elsevier, 2012

Reference books:

1. CUDA by example: An introduction to General Purpose GPU Programming, Jason, Sanders, . Edward Kandrit, Perason, 2011
2. CUDA Programming, Shame Cook, Elsevier
3. High Performance Heterogeneous Computing, Jack Dongarra, Alexey & Lastovetsky , Wiley
4. Parallel computing theory and practice, Michel J.Quinn, TMH

IV-Year-I Semester	Edge Computing (Open Elective-4)	L	T	P	C
OE4102		3	0	0	3

Course objectives:
The main objective is to gain knowledge on how edge computing and Internet of Things (IoT) can be used to meet application demands in intelligent IoT systems

Unit–1: (10 hrs)
IoT and Edge Computing Definition and Use Cases: Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.

Unit–2: (9 hrs)
IoT Architecture and Core IoT Modules-A connected ecosystem, IoT versus machine-to-machine versus, SCADA, the value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective

Unit–3: (9 hrs)
RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.

Unit–4: (10 hrs)
Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.

Unit–5: (10 hrs)
Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand use of the IoT architecture with its entities and protocols, from the IoT devices

CO2 Security and privacy issues related to the area of edge computing and IoT

CO3 Understand the RaspberryPi architecture and its components.

CO4 Work with RaspberryPi components and evaluate its performance.

Text books:

1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806
2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322

Reference books:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984
2. David Jensen, “Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE.

IV-Year-I Semester	Power BI	L	T	P	C
SAC4101	(Skill Advanced Course)	0	0	4	2

Course Objectives:

1. To Learn to design robust data models and amazing reports to improve business intelligence

Course Outcomes:

CO-1: Analyze power BI workflow

CO-2: Summarize Power BI data visualization techniques

CO-3: Summarize Power BI reporting approaches

List of Experiments

1. Installation and overview in power BI Desktop.
2. Import the data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system and build Relationship between Tables.
3. Perform the Extraction Transformation and Loading (ETL) on Data.
4. Create different visualization in a report.
5. Create Reports Using set Interactions between Visuals, Hierarchies and Drilldown, Drill through into Power BI.
6. Create Reports Using Aggregation functions calculate a (scalar) value such as count, sum, average, minimum, or maximum for all rows in a column or table as defined by the expression.
7. Create Reports Using calculations based on dates and time.
8. Create Reports Using MTD QTD YTD in Power BI
9. Create Reports Using filter functions in DAX.
10. Publish the Power BI project report and create a dashboard.

IV-Year-I Semester	Competitive Coding	L	T	P	C
SAC4101	(Skill Advanced Course)	0	0	4	2

Course Objective: the main objective of this course is to make the student familiar with competitive coding by addressing different algorithm-based problems.

List of Experiments:

1. Finding out Twin primes in the given range.
2. Validate a PAN card number.
3. Implementing problems using regular expressions on checking password validity.
4. Implementing towers of Hanoi problem
5. Display the spiral matrix of size nxn.
6. Finding whether a given expression is balanced or not.
7. Finding the addition of two longest integers.
8. Finding out longest common prefix in the given string.
9. Sum of longest subsequences
10. Find out longest palindrome subsequence.
11. Finding number of distinct subsequences.
12. Construct a random Binary tree.
13. Euclidean based algorithms
14. Non-recursive tree traversals – inorder, preorder, postorder, level order.
15. Construct an expression tree.
16. Displaying the binary tree in the form of bird’s eye view.
17. Check whether a given graph holds a cycle or not
18. Find the number of islands in the given specific area.

IV-Year-II Semester	Community Service Project	L	T	P	C
PROJ4202		0	0	0	4

CSP (Community Service Project) is evaluated in the Final Year and 4 credits will be awarded by splitting the credits from if IV Year – II Semester Major Project as per the Proceedings No. JNTUK/DAP/CSP/Distribution of Credits/2022 dated on 24-09-2022.

SYLLABUS FOR HONORS

II-Year-II Semester	Advanced Python Programming	L	T	P	C
HO2201		3	0	2	4

Course objectives:

The main objectives are

1. teach advanced concepts in Python
2. to use advanced packages like numpy, scipy, opencv in Python for building data processing & visualizing applications.
3. to process digital imaging applications

Unit–1: (10 hrs)

Python Fundamentals: Introduction to Python, Data Structures – List, Dictionaries, Sets and Tuples.

Modules, Python Packages, Libraries: Modules - Creating modules, import statement, from Import statement, name spacing. Math Module: Constants, Power and logarithmic functions, Trigonometric functions. Numpy Library: Numpy import, Basic functions, Matrices Addition, Subtraction Multiplication, Transpose, Inverse, Eigen values and Eigenvectors using Numpy

Unit–2: (10 hrs)

Python packages: Introduction to PIP, Installing Packages via PIP, Using Python Packages

Data Visualization – Matplotlib - Loading the library and importing the data, How Mat plot lib works?, modifying the appearance of a plot, Plotting multiple plots, Modifying the tick marks, Scatter plots, Bar plots.

Unit–3: (10 hrs)

File Handling – Introduction to Files, File modes, Reading, Writing data from files, Copy one file to another, deletion of files. Other file programs in Python.

Text Processing: Word, character and line counting, Frequency count. Usage of with() and split(). Reading and writing into CSV formats.

Unit–4: (10 hrs)

Image Processing - Installing Jupiter notebook. Image & Its properties. Image processing applications. Image I/O and display with Python, Reading, saving, and displaying an image using Open CV - PyPI, matplotlib

Sample programs – Image statistics Croping, Converting images from RGB to Gray and resizing the image.

Unit–5: (8 hrs)

Using Databases and SQL – Introduction to Database Concepts, usage of SQLite, Create, Insert & Retrieve data, Spidering twitter using a database. Sample Python codes

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Recall the usage of Python Concepts.
CO2 Use different Python packages for Data Visualization
CO3 Demonstrate File handling & text processing
CO4 Demonstrate applications that performs Image processing
CO5 Connect database with Python

Text books:

1. Python for Everybody: Exploring Data Using Python 3, Charles Severance
2. The Hitchiker's Guide to Python, O'Reilly publication

Reference books:

1. Hands-On Image Processing with Python, O'Reilly Publications
2. Think Python, Allen Downey, Green Tea Press

e-resources:

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/106/106/106106145/#
3. https://realpython.com/python-mysql/

II-Year-II Semester	Software Testing Methodologies	L	T	P	C
HO2201		3	0	2	4

Course objectives:
The main objectives are

1. Describe the principles and procedures for designing test cases.
2. Provide supports to debugging methods.
3. Acts as the reference for software testing techniques and strategies.

Unit–1: (10 hrs)
Introduction: Purpose of Testing, Dichotomies, Model for Testing, Consequences of Bugs, Taxonomy of Bugs. Flow graphs and Path testing: Basics Concepts of Path Testing, Predicates, Path Predicates and Achievable Paths, Path Sensitizing, Path Instrumentation, Application of Path Testing.

Unit–2: (9 hrs)
Transaction Flow Testing: Transaction Flows, Transaction Flow Testing Techniques. Data flow testing: Basics of Dataflow Testing, Strategies in Dataflow Testing, Application of Dataflow Testing.

Unit–3: (11 hrs)
Domain Testing: Domains and Paths, Nice & Ugly Domains, Domain testing, Domains, and Interfaces Testing, Domain and Interface Testing, Domains, and Testability. Paths, Path products, and Regular expressions: Path Products & Path Expression, Reduction Procedure, Applications, Regular Expressions & Flow Anomaly Detection.

Unit–4: (9 hrs)
Syntax Testing: Why What and How, A Grammar for formats, Test Case Generation, Implementation and Application and Testability Tips. Logic-Based Testing: Overview, Decision Tables, Path Expressions, KV Charts, and Specifications.
State, State Graphs, and Transition Testing: State Graphs, Good & Bad State Graphs, State Testing, and Testability Tips.

Unit–5: (9 hrs)
Software Testing Tools: Introduction to Testing, Automated Testing, Concepts of Test Automation, Introduction to list of tools like Win runner, Load Runner, JMeter, About Win Runner ,Using Win runner, Mapping the GUI, Recording Test, Working with Test, Enhancing Test, Checkpoints, Test Script Language, Putting it all together, Running and Debugging Tests, Analyzing Results, Batch Tests, Rapid Test Script Wizard.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the basic testing procedures.
CO2 support in generating test cases and test suites.
CO3 test the applications manually by applying different design testing methods
CO4 test the applications manually by applying different syntax testing methods
CO5 Apply tools to resolve the problems in the Real-time environment.

Text books:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech.

Reference books:

1. Software Testing Techniques – SPD(Oreille)
2. Software Testing in the Real World – Edward Kit, Pearson
3. Effective methods of Software Testing, Perry, John Wiley.

II-Year-II Semester	Advanced Data Structures	L	T	P	C
HO2201		3	0	2	4

Course objectives:
The main objectives are

1. Single Linked, Double Linked Lists, Stacks, Queues, Searching and Sorting techniques, Trees, Binary trees, representation, traversal, Graphs- storage, traversal.
2. Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees
3. AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees

Unit–1: (10 hrs)
Introduction to Data Structures- Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms, Stacks and Queues- Algorithm Implementation using Linked Lists.
Unit–2: (10 hrs)
Searching- Linear and Binary, Search Methods, Sorting- Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Trees- Binary trees, Operations- Insertion, Deletion, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix), Graphs- Basic Concepts, Storage structures and Traversals.
Unit–3: (10 hrs)
Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing- Linear Probing, Double Hashing.
Unit–4: (10 hrs)
Priority queues- Definition, ADT, Realising a Priority Queue Using Heaps, Definition, Insertion, Deletion, Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations- Searching, Insertion, Deletion.
Unit–5: (8 hrs)
Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations Insertion, Deletion and Searching. Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Ability to write and analyze algorithms for algorithm correctness and efficiency

CO2 Master a variety of advanced abstract data type (ADT) and data structures and their Implementation

CO3 Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real life.

CO4 Design and implement variety of data structures including linked lists, binary trees, heaps, graphs, and search trees

CO5 Ability to compare various search trees and find solutions for IT related problems

Text books:

1. Data Structures: A Pseudocode Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon, Cengage
2. Data Structures, Algorithms and Applications in java, 2/e, SartajSahni, University Press

Reference books:

1. Data Structures And Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
2. Data Structures And Algorithms, 3/e, Adam Drozdek, Cenage.
3. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N. B. Venkateswarulu, E.V. Prasad, S Chand & Co, 2009
4. Classic Data Structures, Second Edition, Debasis Samantha ,PHI

II-Year-II Semester	Natural Language Processing	L	T	P	C
HO2201		3	0	2	4

Course objectives:
The main objectives are
1. To understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
2. To conceive basic knowledge on various morphological, syntactic, and semantic NLP tasks.
3. To familiarize various NLP software libraries and data sets publicly available.
4. To develop systems for various NLP problems with moderate complexity
5. To learn various strategies for NLP system evaluation and error analysis.

Unit–1: (9 hrs)
Introduction to NLP: Introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English.

Unit–2: (9 hrs)
Language Modelling: N-gram and Neural Language Models, Language Modelling with N-gram, Simple N-gram models, Smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development

Unit–3: (10 hrs)
Parts-of-speech Tagging Parts-of-speech Tagging: basic concepts; Tagset; Early approaches: Rule based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model.

Unit–4: (10 hrs)
Parsing Basic concepts: top down and bottom up parsing, treebank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.

Unit–5: (10 hrs)
Semantics Vector Semantics: Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW; Concept of Word Sense; Introduction to WordNet

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.

CO2 Demonstrate understanding of the relationship between NLP and statistics & machine learning.

CO3 Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis.

CO4 Develop systems for various NLP problems with moderate complexity.

CO5 Evaluate NLP systems, identify shortcomings and suggest solutions for these shortcomings.

Text books:

1. Jurafsky Dan and Martin James H. "Speech and Language Processing" ,3rd Edition, 2018.

Reference books:

1. Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition," 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
2. Goldberg Yoav "A Primer on Neural Network Models for Natural Language Processing."

III-Year-I Semester	Advanced Operating Systems	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems)
2. Hardware and software features that support these systems.

Unit–1: (10 hrs)

Architectures of Distributed Systems: System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.

Theoretical Foundations:

Inherent Limitations of a Distributed System, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection

Unit–2: (9 hrs)

Distributed Mutual Exclusion: The Classification of Mutual Exclusion Algorithms,

Non-Token –Based Algorithms: Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm,

Token-Based Algorithms: Suzuki-Kasami's Broadcast Algorithm, Singhal's Heurisric Algorithm, Raymond's Heuristic Algorithm

Unit–3: (9 hrs)

Distributed Deadlock Detection: Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized- Deadlock – Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms.

Unit–4: (10 hrs)

Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, Basic Multiprocessor System Architectures **Multi Processor Operating Systems**: Introduction, Structures of Multiprocessor Operating Systems, Operating Design Issues, Threads, Process Synchronization, Processor Scheduling.

Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues

Unit–5: (10 hrs)

Distributed Scheduling: Issues in Load Distributing, Components of a Load Distributed Algorithm, Stability, Load Distributing Algorithms, Requirements

for Load Distributing, Task Migration, Issues in task Migration
Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the design approaches of advanced operating systems
CO2 Analyze the design issues of distributed operating systems
CO3 Evaluate design issues of multi-processor operating systems
CO4 Identify the requirements Distributed File System and Distributed Shared Memory
CO5 Formulate the solutions to schedule the real time applications

Text books:

1. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata
   McGraw-Hill Edition 2001.

Reference books:

1. Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall,
   Edition – 2, 2007

III-Year-I Semester	Cyber Law & Ethics	L	T	P	C
HO3101		3	0	2	4

Course objectives:
The main objectives are

1. To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
2. To develop some ideas of the legal and practical aspects of their profession.

Unit–1: (10 hrs)
Introduction to Computer Security: Definition, Threats to security, Government requirements, Information Protection and Access Controls, Computer security efforts, Standards, Computer Security mandates and legislation, Privacy considerations, International security activity.

Unit–2: (9 hrs)
Secure System Planning and administration, Introduction to the orange book, Security policy requirements, accountability, assurance and documentation requirements, Network Security, The Red book, and Government network evaluations

Unit–3: (9 hrs)
Information security policies and procedures: Corporate policies- Tier 1, Tier 2 and Tier3 policies - process management-planning and preparation-developing policies-asset classification policy developing standards.

Unit–4: (10 hrs)
Information security: fundamentals-Employee responsibilities- information classification Information handling- Tools of information security- Information processing-secure program administration

Unit–5: (10 hrs)
Organizational and Human Security: Adoption of Information Security Management Standards, Human Factors in Security- Role of information security professionals.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 The students will understand the importance of professional practice, Law and Ethics in their personal lives and professional careers

CO2 The students will learn the rights and responsibilities as an employee, team member and a global citizen

Text books:

1. Debby Russell and Sr. G. T Gangemi, "Computer Security Basics

(Paperback)," 2nd Edition, O' Reilly Media, 2006.

2. Thomas R. Peltier, "Information Security policies and procedures: A Practitioner's Reference," 2nd Edition Prentice Hall, 2004.

Reference books:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions," IGI Global, 2009.
2. Thomas R Peltier, Justin Peltier, and John blackley," Information Security Fundamentals," 2nd Edition, Prentice Hall, 1996
3. Jonathan Rosenoer, "Cyber law: the Law of the Internet," Springer-verlag, 1997
4. James Graham, "Cyber Security Essentials" Averbach Publication T & F Group.

III-Year-I Semester	Advanced Database Systems	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To design high-quality relational databases and database applications.
2. To develop skills in advanced visual& conceptual modeling and database design.
3. To translate complex conceptual data models into logical and physical data Base designs.
4. To develop an appreciation of emerging database trends as they apply to semi-structured data, the internet, and object-oriented databases

Unit–1: (10 hrs)

Algorithms for Query Processing and Optimization:

Translating SQL queries into relational algebra- algorithms for external sorting-algorithms for select and join operations-algorithms for project and set operations-implementing aggregate operations and outer joins-combining operations using pipelining-using heuristics in query optimization.

Unit–2: (9 hrs)

Data base systems architecture and the system Catalog:

System architectures for DBMSs, Catalogs for Relational DBMSs, System catalog information in oracle. Practical database design and tuning: Physical Database Design in Relational Databases-an overview of Database Tuning in Relational systems

Unit–3: (9 hrs)

Distributed DBMS Concepts and Design:

Introduction-function and architecture of a Distributed DBMS- Distributed Relational Database Design-transparencies in a Distributed DBMS-Date's Twelve Rules for Distributed DBMS. Distributed DBMS-Advanced Concepts: Distributed Transaction Management-Distributed Concurrency Control-Distributed Deadlock Management-Distributed Database Recovery-The X/Open Distributed Transaction processing model-Replication Servers.

Unit–4: (10 hrs)

Introduction to Object DBMSs:

Advanced Database Applications-Weaknesses of RDBMSs-Object oriented Concepts-Storing objects in a Relational Database-Next generation Database systems. Object-Oriented DBMSs-Concepts and Design :Introduction to Object-Oriented Data Models and DBMSs-OODBMS perspectives-Persistence-Issues in OODBMSs-The object-Oriented Database System Manifesto-Advantages and Disadvantages of OODBMSs-Object oriented Database Design

Unit–5: (10 hrs)

Emerging database technologies and applications:

Hadoop, BIg Data characteristics, NO SQL databases, BASE, Brewer's theorem, Relationship between CAP, ACID and No SQL databases, comparison with Relational databases, No SQL databases types, Comparative study of NoSQL products, Case studies using Mango DB and Cassandra.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Identify, describe, and categorize database objects

CO2 Design and implement advanced queries using Structured Query Language

CO3 Design, construct and maintain a database and various database objects using procedural language constructs, forms, and reports to solve problems

CO4 Administer a database by recommending and implementing procedures including database tuning, backup, and recovery

CO5 Propose, implement, and maintain database security mechanisms

Text books:

1. "Fundamentals of Database Systems," Elmasri Navate, 5/e, Pearson Education.
2. Principles of distributed databases S Ceri and Palgettgi TMH
3. Getting started with No SQL Databases , Gaurav Vaish

Reference books:

1. "Principles of Distributed Database Systems," Ozsu, 2/e, PHI.

III-Year-I Semester	Sentiment Analysis	L	T	P	C
HO3101		3	0	2	4

Course objectives:
The main objectives are
1. To study concepts of Sentiment analysis and opinion mining. Sentiment analysis and opinion mining is the field of study that analyzes people's opinions, sentiments, evaluations, attitudes, and emotions from written language.
2. To perform active research in natural language processing and is also widely studied in data mining, Web mining, and text mining.

Unit–1: (10 hrs)
Sentiment Analysis Applications, Sentiment Analysis Research, Sentiment Analysis Research, and Opinion Spam Detection.
Problem of Sentiment Analysis: Problem Definitions, Opinion Summarization, Different Types of Opinions, Subjectivity and Emotion, Author, and Reader Standing Point.
Unit–2: (9 hrs)
Sentiment Classification Using Supervised Learning, Sentiment Classification Using Unsupervised Learning, Sentiment Rating Prediction, Cross-Domain Sentiment Classification, Cross-Language Sentiment Classification.
Unit–3: (9 hrs)
Sentence Subjectivity: Subjectivity Classification, Sentiment Classification, Dealing with Conditional Sentences, Dealing with Sarcastic Sentences, Cross-language Subjectivity and Sentiment Classification, Using Discourse Information for Sentiment Classification.
Unit–4: (10 hrs)
Basic Rules of Opinions and Compositional Semantics, Aspect Extraction, Identifying Resource Usage Aspect, Simultaneous Opinion Lexicon Expansion and Aspect Extraction, Grouping Aspects into Categories, Entity, Opinion Holder and Time Extraction, Word Sense Disambiguation
Unit–5: (10 hrs)
Problem Definitions, Identify Comparative Sentences, Identifying Preferred Entities. Web Search vs. Opinion Search, Existing Opinion Retrieval Techniques Types of Spam and Spamming, Supervised Spam Detection, Unsupervised Spam Detection, Group Spam Detection. Quality as Regression Problem, Other Methods.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 understanding of concepts and theories of Sentiment Anslysis.

CO2 understanding of related concepts in machine learning, data mining, and natural language processing

CO3 proficiency in Python programming, and specifically the use of the Natural Language Toolkit to solve problems in Sentiment Analysis

CO4 understanding of research approaches in Sentiment Analysis through conducting experiments and writing up results in research paper form.

Text books:

1. Sentiment Analysis and Opinion Mining, Bing Liu.

Reference books:

1. Journals: Computational Linguistics, Natural Language Engineering, Artificial Intelligence.
2. Conferences: Annual Meeting of the Association of Computational Linguistics (ACL), Computational Linguistics(COLING), European ACL (EACL), Empirical Methods in NLP (EMNLP), Human Language Technology (HLT), International Conference on Natural Language Processing (ICON).

III-Year-II Semester	RFID and Micro Controllers	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To learn the basics of RFID and 8051 microcontrollers
2. Interfacing RFID with microcontrollers
3. To develop real time applications based on microcontrollers.
4. Analyze different case studies.

Unit–1: (10 hrs)

BAR CODES AND RFID

Bar codes and RFID basics- Components of an RFID system-Data -Tags-Antennas Connectors- Cables- Readers- encoder/ printers for smart labels-Controllers software- RFID advantages over Bar codes.

Unit–2: (9 hrs)

MICROCONTROLLERS

Intel 8051 - architecture- memory organization- special function registers-timing and control- port operation- memory interfacing - I/O interfacing-Programming the 8051 resources- interrupts- Measurement of frequency, period, and pulse width of a signal power down operation.

Unit–3: (9 hrs)

INTEL 8051 MICROCONTROLLER- INSTRUCTION SET AND PROGRAMMING

Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions.- 8051 Interfacing and applications.

Unit–4: (10 hrs)

RFID APPLICATIONS

Short range RFID applications- access control - personal identification - Transportation ticketing- blood , tissue, and organ identification- fleet management personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping-Clothing Tags.

Unit–5: (10 hrs)

CASE STUDIES

Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment- smart shipping containers fleet monitoring and management.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Learn about RFID and its applications

CO2 Work with Microcontrollers, RFID tags & Readers

CO3 Understand and Implement Microcontroller Programming

Text books:

1. Dennis E. Brown, "RFID implementation" Tata McGraw - Hill, 2007
2. Steven Shepard, "RFID: Radio frequency and Identification," Tata McGraw - Hill.
3. Ajit Pal, "Microcontrollers- principles and applications," Prentice Hall of India, 2011

Reference books:

3. Krishna Kant. "Microprocessors and Microcontrollers," Prentice Hall of India, 2011 5.
4. www.circuitstoday.com/interfacing-rfid-module-to-8051

III-Year-II Semester	Energy harvesting technologies and power management for IoT Devices	L	T	P	C
HO3101		3	0	2	4

Course objectives:
The main objectives are
1. To learn the techniques in involved in Energy harvesting
2. To understand the various energy sources and energy harvesting based sensor networks
3. To learn about the various Piezoelectric materials and Non-linear techniques
4. To understand the various Power sources for WSN
5. To learn about the applications of Energy harvesting systems.

Unit–1: (10 hrs)
ENERGY HARVESTING SYSTEMS
Introduction – Energy sources – energy harvesting based sensor networks – photovoltaic cell technologies – generation of electric power in semiconductor PV cells – types
Unit–2: (9 hrs)
PIEZO-ELECTRIC ENERGY HARVESTING AND ELECTROMECHANICAL MODELING
Piezoelectric materials – transducers – harvesters – microgenerators – strategies for enhancing the performance of energy harvesters. Electromechanical modeling of Lumped parameter model and coupled distributed parameter models and closed-form solutions
Unit–3: (9 hrs)
ELECTROMAGNETIC ENERGY HARVESTING AND NON-LINEAR TECHNIQUES
Basic principles – micro fabricated coils and magnetic materials – scaling – power maximations – micro and macro scale implementations. Non-linear techniques – vibration control & steady state cases.
Unit–4: (10 hrs)
ENERGY HARVESTING WIRELESS SENSORS
Power sources for WSN – Power generation – conversion – examples – case studies.
Harvesting microelectronic circuits – power conditioning and losses
Unit–5: (10 hrs)
SELECTED APPLICATIONS OF ENERGY HARVESTING SYSTEMS
Case studies for Implanted medical devices – Bio-MEMS based applications – harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understand the various energy sources and energy harvesting based sensor networks

CO2 Learn about the various Piezoelectric materials and Non-linear techniques

CO3 Understand the various Power sources for WSN

CO4 Learn about the applications of Energy harvesting systems

Text books:

1. Carlos Manuel Ferreira Carvalho, Nuno Filipe Silva VerissimoPaulino, "CMOS Indoor Light Energy Harvesting System for Wireless Sensing Applications," springer.

Reference books:

1. Danick Briand, Eric Yeatman, Shad Roundy ,"Micro Energy Harvesting"

III-Year-II Semester	Database Security and Privacy	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To understand the fundamentals of security, and how it relates to information systems.
2. To identify risks and vulnerabilities in operating systems from a database perspective.
3. To learn good password policies, and techniques to secure passwords in an organization.
4. To learn and implement administration policies for users
5. To understand the various database security models and their advantages or disadvantages.

Unit–1: (10 hrs)

SECURITY ARCHITECTURE & OPERATING SYSTEM SECURITY FUNDAMENTALS

Security Architecture: Introduction-Information Systems- Database Management Systems-Information Security Architecture- Database Security–Asset Types and value-Security Methods. Operating System Security Fundamentals: Introduction-Operating System Overview-Security Environment – Components- Authentication Methods-User Administration-Password Policies Vulnerabilities-E-mail Security.

Unit–2: (9 hrs)

ADMINISTRATION OF USERS & PROFILES,PASSWORD POLICIES, PRIVILEGES AND ROLES

Administration of Users: Introduction-Authentication-Creating Users, SQL Server User-Removing, Modifying Users-Default, Remote Users-Database Links-Linked Servers-Remote Servers-Practices for Administrators and Managers-Best Practices Profiles, Password Policies, Privileges and Roles: Introduction-Defining and Using Profiles-Designing and Implementing Password Policies-Granting and Revoking User Privileges-Creating, Assigning and Revoking User Roles-Best Practices

Unit–3: (9 hrs)

DATABASE APPLICATION SECURITY MODELS & VIRTUAL PRIVATE DATABASES

Database Application Security Models: Introduction-Types of Users-Security Models- Application Types-Application Security Models-Data Encryption Virtual Private Databases: Introduction-Overview of VPD-Implementation of VPD using Views, Application Context in Oracle-Implementing Oracle VPD-Viewing VPD

Policies and Application contexts using Data Dictionary, Policy Manager Implementing Row and Column level Security with SQL Server.

Unit–4: (10 hrs)

AUDITING DATABASE ACTIVITIES

Auditing Database Activities: Using Oracle Database Activities-Creating DLL Triggers with OracleAuditing Database Activities with Oracle-Auditing Server Activity with SQL Server 2000-Security and Auditing Project Case Study.

Unit–5: (10 hrs)

PRIVACY PRESERVING DATA MINING TECHNIQUES

Privacy Preserving Data Mining Techniques: Introduction- Privacy Preserving Data Mining Algorithms General Survey-Randomization Methods-Group Based Anonymization-Distributed Privacy Preserving Data Mining-Curse of Dimensionality-Application of Privacy Preserving Data Mining

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Design and implement secure database systems.

CO2 Identify security threats in database systems.

CO3 Solve Complex Problems in a Team of database works.

Text books:

1. Hassan A. Afyouni, "Database Security and Auditing," Third Edition, Cengage Learning, 2009.
2. Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 2008

Reference books:

1. Ron Ben Natan, "Implementing Database Security and Auditing," Elsevier Digital Press, 2005.
2. http://charuaggarwal.net/toc.pdf
3. http://adrem.ua.ac.be/sites/adrem.ua.ac.be/files/securitybook.pdf

III-Year-II Semester	Computer Vision	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. Be familiar with both the theoretical and practical aspects of computing with images.
2. Have described the foundation of image formation, measurement, and analysis.
3. Understand the geometric relationships between 2D images and the 3D world.
4. Grasp the principles of state-of-the-art deep neural networks.

Unit–1: (10 hrs)

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing, and Binary image analysis.

Unit–2: (9 hrs)

Edge detection, Edge detection performance, Hough transform, corner detection

Unit–3: (9 hrs)

Segmentation, Morphological filtering, Fourier transform.

Unit–4: (10 hrs)

Feature extraction, shape, histogram, color, spectral, texture, using CV IP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing

Unit–5: (10 hrs)

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Recent trends in Activity Recognition, computational photography, Biometrics.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Identify basic concepts, terminology, theories, models, and methods in the field of computer vision.

CO2 Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion, and object recognition.

CO3 Developed the practical skills necessary to build computer vision applications.

CO4 To have gained exposure to object and scene recognition and categorization from images.

Text books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Computer Vision – A modern approach, by D.Forsyth and J.Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Reference books:

1. Deep Learning, by Goodfellow, Bengio, and Courville.
2. Dictionary of Computer Vision and Image Processing, by Fisher et al.
3. Three-Dimensional Computer Vision, by Olivier Faugeras, The MIT Press.

III-Year-II Semester	Robotics and Automation in Food Industry	L	T	P	C
HO3101		3	0	2	4

Course objectives:
The main objectives are
1. To introduce the need for robotics and automation in food industry.
2. Provide an overview of the sensors and gripper mechanisms for food sector.
3. Understanding the various applications of automation in food industry.

Unit–1: (10 hrs)
Introduction
Process Control Systems and Structure in the Food Industry – Process Control Methods – Robotics in the food industry – Automation – Specification for a food sector robot – future trends.
Unit–2: (9 hrs)
Sensors and Automation
Sensors for automated food process control – Special Considerations – Measurement Methods – Device Integration – Applications - Machine Vision-Optical Sensors – SCADA in food industry
Unit–3: (9 hrs)
Gripper Technology
Gripper Challenges in food industry – Gripping Physics – Pinching and enclosing grippers – Penetrating Grippers – Suction Grippers – Surface Effect Grippers –Selection of appropriate gripping mechanism.
Unit–4: (10 hrs)
Sensor Networks and Intelligent Quality Control Systems
Wireless sensor networks – applications in agriculture and food production – future trends – intelligent control systems using fuzzy logic
Unit–5: (10 hrs)
Advanced Methods for control of food processes
Introduction – Case Study of Bio conversion in a batch fed reactor – Design of PID Controller for fed batch process – Real time optimization.

Course Outcomes: Upon successful completion of the course, the student will be able to
CO1 Specify the characteristics of robots used in food industry.
CO2 Identify the applications of sensors in food industry.
CO3 Describe about the different types of gripper mechanisms
CO4 Describe the use of sensor networks and quality control in food sector
CO5 Discuss about the advanced methods for control of food process.

Text books:

1. Darwin Caldwell, Robotics and Automation in the Food Industry – Current and Future Technologies" Woodhead Publishing, 2013.
2. Moore.C.A., "Automation in Food Industry," Springer, 2012.

Reference books:

1. Selwyn Piramuthu and Wie Zhou "RFID and Sensor Network Automation in the Food Industry," Wiley Blackwell, 2016.
2. Luo Zongwei, "Robotics, Automation and Control in Industrial and Service Settings," Advances in Civil and Industrial Engineering, 2015.
3. Jonathan Love, "Process Automation Handbook: A Guide to Theory and Practice," Springer, 2007.
4. Fellows. P. J. "Food Processing Technology: Principles and Practice," Woodhead Publishing, 2009.
5. Mittal, "Computerized Control Systems in the Food Industry," Routledge, 2018.

III-Year-II Semester	Design and Testing of Digital Systems	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To impart knowledge on combinational and sequential circuits.
2. To design digital circuits.
3. To test combinational and sequential circuits using testability algorithms.

Unit–1: (10 hrs)

COMBINATIONAL CIRCUIT DESIGN AND SIMULATION USING GATES

Review of Combinational Circuit Design-Design of Circuits with limited gate fan-in- Gate delays and timing diagrams-Hazards in Combinational Logic-Simulation and testing of Logic Circuits-Multiplexer, three-state buffers, and Decoder/Encoders

Unit–2: (9 hrs)

COMBINATIONAL CIRCUITSDESIGN WITH PROGRAMMABLE LOGIC DEVICES AND VHDL

Designing with ROMs-Programmable Logic Devices-Complex Programmable Logic Devices-Field Programmable gate Arrays-VHDL Description of combinational Circuits- VHDL models for Multiplexers-VHDL Modules and Operators-Signals, constants, and Arrays-IEEE Standard Logic

Unit–3: (9 hrs)

SEQUENTIAL CIRCUITS DESIGN

Sequential Parity Checker-Analysis by Signal Tracing and Timing Charts-State Tables and Graphs-Construction and Interpretation of Timing Charts-General Models-Code converter-design Example-Design of Sequential Circuits using ROMs and PLAs

Unit–4: (10 hrs)

FAULT MODELING AND SIMULATION

Keyboard basics - Keyboard scanning algorithm - Character LCD modules – LCD module display Configuration - Time-of-day clock - Timer manager - Interrupts - Interrupt service routines - Interrupt-driven pulse width modulation.Triangle waves analog vs. digital values - Auto port detect - Capturing analog information in the timer interrupt service routine - Automatic, multiple channel analog to digital data acquisition.

Unit–5: (10 hrs)

TESTING FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS

Basic Issues-ATG for SSFs in Combinational Circuits- Fault oriented ATG-Common Concepts, Algorithms and Selection Criteria-ATG for SSFs in Sequential Circuits

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Develop a digital logic and apply it to solve real life problems

CO2 Develop competence in Combinational Logic Problem formulation and Logic Optimization

CO3 Develop competence in analysis of synchronous and asynchronous sequential circuits

CO4 Analyze and solve various engineering problems with finite state machine

CO5 Design and analyze Logic gates with different technologies

Text books:

1. Charles H. Roth, Jr.LarryL.Kinney, "Fundamentals of Logic design" Cenage Learning, 6th Edition, 2010
2. MironAbramovici, Melvin A. Breuer and Arthur D. Friedman, "Digital Systems Testing and Testable Design," Jaico Publishing House, 2001.

Reference books:

1. Morris Mano, M.D.Ciletti, "Digital Design" , Pearson Edition, 2013
2. Peatman, "Design of digital Systems," McGraw-Hill, 1984
3. Adamski and Barkalov, "Design of Digital Systems and Devices, Springer Science & Business Media, 2011

III-Year-II Semester	Kernel and Driver Programming	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. To learn the fundamental of device driver and write simple device driver programs
2. To learn the debugging technique and study the concurrency and trace conditions
3. To learn memory allocation and write driver programs for communicating with hardware
4. To learn about the interrupt handling, PCI driver and USB driver
5. To learn the block driver and network driver.

Unit–1: (10 hrs)

INTRODUCTION TO DEVICE DRIVER AND CHAR DRIVER

Introduction to device driver - The Role of the Device Driver –Splitting the Kernel - Classes of Devices and Modules - Security Issues – Building and running modules – Setting your test system – compiling and loading - Char Drivers - Design of scull - Some Important Data Structures - Char Device Registration - open and release - scull's Memory Usage - read and write - Playing with the New Devices.

Unit–2: (9 hrs)

DEBUGGING TECHNIQUE, CONCURRENCY AND TRACE CONDITIONS

Debugging technique -Concurrency and trace conditions – Pitfalls in scull - Concurrency and Its management - Semaphores and Mutexes - Completions – Spinlocks - Locking Traps - Alternatives to Locking - Advanced Char driver operations – ioctl 135 - Blocking I/O 147 - poll and select 163 - Asynchronous Notification - Seeking a Device - Access Control on a Device File

Unit–3: (9 hrs)

MEMORY ALLOCATION, COMMUNICATING WITH HARDWARE

Time, delays, and deferred work – Allocating memory – The Real Story of kmalloc - Lookaside Caches - get_free_page and Friends - vmalloc and Friends - Per-CPU Variables - Obtaining Large Buffers - Communicating with hardware – I/O Ports and I/O Memory - Using I/O Ports - I/O Port Example - Using I/O Memory

Unit–4: (10 hrs)

INTERRUPT HANDLING, DATA TYPES, PCI DRIVER, AND USB DRIVER

Interrupt handling - Preparing the Parallel Port - Installing an Interrupt Handler - Implementing a Handler - Top and Bottom Halves - Interrupt Sharing - Interrupt-Driven I/O - Data types in kernel – Use of Standard C Types -

Assigning an Explicit Size to Data Items - Interface-Specific Types - Other Portability Issues - Linked Lists – PCI drivers - PCI Interface - PC/104 and PC/104+ - Other PC Buses - USB drivers – USB and Sysfs - USB Urbs - Writing a USB Driver - USB Transfers Without Urbs

Unit–5: (10 hrs)

LINUX DEVICE MODEL, BLOCK DRIVER AND NETWORK DRIVERS

Linux device model - Kobjects, Ksets, and Subsystems - Low-Level Sysfs Operations - Hotplug Event Generation - Buses, Devices, and Drivers – Classes – Hotplug – Block Driver – Registration - Block Device Operations - Request Processing – Network Drivers

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Understanding the design of Linux kernel components

CO2 Experiencing the kernel by passive/active observation

CO3 Extending the Linux kernel for understanding, self-satisfaction/falsification

CO4 Exploring current research trends in OS, Linux being the reference OS

Text books:

1. Robert love "Linux Kernel Development" Pearson Publication, Third edition 2010.

Reference books:

1. Beck Michael et al "Linux Kernel Programming" Pearson Publication, Third edition 2015
2. Mohan LalJangir "Linux kernel and device driver programming," Laxmi Publication, 2014

III-Year-II Semester	SDN and NFV for IoT	L	T	P	C
HO3101		3	0	2	4

Course objectives:

The main objectives are

1. Understand the principles behind the Modern Network approaches such as SDN NFV and IoT.
2. Ability to analyze Data Center topologies and virtualized environment.
3. Understand the data traversal over virtualized environment for IoT.
4. Design algorithms for virtualization over multi-tenant environments
5. Understand the various types of key routing and switching techniques used in modern networks

Unit–1: (10 hrs)

MODERN NETWORKING

Cloud Computing - Internet of Things - Types of Network and Internet Traffic - Demand: Big Data, Cloud Computing, and Mobile Traffic - Requirements: QoS and QoE – Routing Congestion Control - SDN and NFV - Modern Networking Elements

Unit–2: (9 hrs)

SOFTWARE DEFINED NETWORKS

Network Requirements - The SDN Approach - SDN- and NFV-Related Standards – SDN Data Plane - OpenFlow Logical Network Device - OpenFlow Protocol - SDN Control Plane Architecture - REST API - SDN Application Plane Architecture

Unit–3: (9 hrs)

VIRTUALIZATION

Background and Motivation for NFV - Virtual Machines - NFV Concepts – NFV Reference Architecture - NFV Infrastructure - Virtualized Network Functions – NFV Management and Orchestration - NFV Use Cases - SDN and NFV.

Unit–4: (10 hrs)

THE INTERNET OF THINGS: COMPONENTS

The IoTEra - Scope of the Internet of Things - Components of IoT-Enabled Things – IoT World Forum Reference Model - ITU-T IoT Reference Model - IoTivity - Cisco IoT System - ioBridge - SDN and NFV over IoT Deployment

Unit–5: (10 hrs)

SECURITY

Security Requirements - SDN Security - NFV Security - ETSI Security Perspective – IoT Security - The Patching Vulnerability - IoT Security and Privacy Requirements Defined by ITU-T - An IoT Security Framework - The Impact of the New Networking on IT Careers

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Evaluate the ambient air quality based on the analysis of air pollutants and relate the polluting plume behavior with weather data

CO2 Identify suitable control methods depending on the severity and type of air pollution

CO3 Classify solid wastes and identify suitable collection and transfer mechanisms

CO4 Suggest suitable solid waste management methods based on the nature of solid waste and the quantities to be handled

CO5 Identify the sources of noise pollution and suggest methods for mitigating the problem

Text books:

1. "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" William Stallings Publisher: Addison-Wesley 2015 ISBN: 9780134175393
2. SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization 1st Edition by Jim Doherty

Reference books:

1. Network Function virtualization with a touch of sdn by Paresh Shah, Syed Farrukh Hassan, RajendraChayapathi
2. Software Defined Networks A Comprehensive Approach Ist Edition by Paul Goransson Chuck Black

IV-Year-I Semester	Biomedical Sensors	L	T	P	C
HO4101		3	0	2	4

Course objectives:
The main objectives are
1. Introduce the students to different types of electrodes used in bio potential recording
2. To facilitate the students in recognizing electrode configuration and issues related with the electrode relative motions.
3. To expose the students to perceive the need for bio amplifiers and their characteristics needed to be design for various bandwidth and frequency response.
4. Review the cardiac, respiratory, and muscular physiological systems. Study the designs of several instruments used to acquire signals from living systems.
5. Applying specific radiology methods in diagnostics and analysis and understand the theory behind the sound and tissue interaction, and able to apply in therapeutic application.

Unit–1: (10 hrs)
Biopotential Electrodes: Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.
Unit–2: (9 hrs)
EEG, EMG & ECG: Bio signal characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar, and average mode. EMG– unipolar and bipolar mode. EEG- procedure, signal artefacts, signal analysis, evoked potential, EMG- procedure and signal analysis, Nerve conduction study
Unit–3: (9 hrs)
Bio Amplifiers: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation-isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference
Unit–4: (10 hrs)
Physical Sensors in Biomedicine: Temperature measurement: core temperature,-surface temperature- invasive. Blood flow measurement: skin blood- hot film anemometer- Doppler sonography- electromagnetic sensor - blood pressure measurement: non-invasive- hemodynamic invasive.

Spirometry- sensors for pressure pulses and movement- ocular pressure sensor- acoustic sensors in hearing aid, in blood flow measurement, sensors for bio-magnetism, tactile sensors for artificial limbs, sensors in ophthalmoscopy, artificial retina

Unit–5: (10 hrs)

Sensors for Chemical Quantities in Biomedicine: Blood gas and pH sensor, electrochemical sensor, transcutaneous, optical fiber sensor, mass spectrometer, optical oximetry, pulse oximetry, ear oximetry.

Detectors in Radiology: X ray imaging with sensors, detectors in nuclear radiology, magnetic field sensors for imaging, magnetic resonance imaging

Sound in Medicine: Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission- Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Realize the need for reusable electrodes and understands the method of implementation

CO2 Will be familiar with electrode placements for various biopotential recording as per the voltage range

CO3 Capable of understanding the design principles of bio-amplifiers and drawback related with noises

CO4 Gain knowledge for implementing different types of physiological parameter measurement using appropriate sensors

CO5 Able to discuss, develop and apply site specific chemical sensors design and imaging techniques for typical issues

Text books:

1. J. G. Webster, J. G. Webster ,"Medical Instrumentation; Application and Design," John Wiley & Sons, Inc., New York, 4th Edition, 2015

Reference books:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation," Tata McGraw-Hill, New Delhi, 3rd edition ,2014
2. John Enderle, Joseph Bronzino, "Introduction to Biomedical Engineering," Academic Press, 3rd Edition, 2011
3. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume 1: Volume I: Biomedical Engineering Fundamentals", McGraw Hill Publisher, USA, 2nd Edition 2009.

IV-Year-I Semester	Ethical Hacking	L	T	P	C
HO4101		3	0	2	4

Course objectives:
The main objectives are

1. The aim of the course is to introduce the methodologies and framework of ethical hacking for enhancing the security.
2. The course includes-Impacts of Hacking; Types of Hackers; Information Security Models; Information Security Program; Business Perspective; Planning a Controlled Attack; Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration)

Unit–1: (10 hrs)
Introduction: Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking

Unit–2: (9 hrs)
The Business Perspective: Business Objectives, Security Policy, Previous Test Results, Business Challenges Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, Timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement

Unit–3: (9 hrs)
Preparing for a Hack: Technical Preparation, Managing the Engagement Reconnaissance: Social Engineering, Physical Security, Internet Reconnaissance

Unit–4: (10 hrs)
Enumeration: Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase Exploitation: Intutive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern.

Unit–5: (10 hrs)
Deliverable: The Deliverable, The Document, Overal Structure, Aligning Findings, Presentation Integration: Integrating the Results, Integration

Summary, Mitigation, Defense Planning, Incident Management, Security Policy, Conclusion

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Gain the knowledge of the use and availability of tools to support an ethical hack

CO2 Gain the knowledge of interpreting the results of a controlled attack

CO3 Understand the role of politics, inherent and imposed limitations, and metrics for planning of a test

CO4 Comprehend the dangers associated with penetration testing

Text books:

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing," Auerbach Publications, CRC Press

Reference books:

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases," Cengage Learning
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense," Cengage Learning

IV-Year-I Semester	Storage Area Networks	L	T	P	C
HO4101		3	0	2	4

Course objectives:
The main objectives are
1. Evaluate storage architectures
2. Define backup, recovery, disaster recovery, business continuity, and replication
3. Examine emerging technologies including IP-SAN
4. Understand logical and physical components of a storage infrastructure
5. Identify components of managing and monitoring the data center
6. Define information security and identify different storage virtualization technologies

Unit–1: (10 hrs)
Storage System: Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application

Unit–2: (9 hrs)
Data Protection - RAID : RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. Intelligent Storage Systems : Components of an Intelligent Storage System, Types of Intelligent Storage Systems. Fibre Channel Storage Area Networks - Fibre Channel: Overview, The SAN and Its Evolution, Components of FC SAN.

Unit–3: (9 hrs)
IP SAN and FCoE: iSCSI, FCIP, Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance

Unit–4: (10 hrs)
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions, Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments

Unit–5: (10 hrs)

Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency , Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas. Remote Replication: Modes of Remote Replication, Remote Replication Technologies. Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains. Security Implementations in Storage Networking

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Identify key challenges in managing information and analyze different storage networking technologies and virtualization

CO2 Explain components and the implementation of NAS

CO3 Describe CAS architecture and types of archives and forms of virtualization

CO4 Illustrate the storage infrastructure and management activities

Text books:

1. EMC Education Services, “Information Storage and Management,” Wiley India Publications, 2009. ISBN: 9781118094839

Reference books:

1. Paul Massiglia, Richard Barker, "Storage Area Network Essentials: A Complete Guide to Understanding and Implementating SANs Paperback", 1st Edition, Wiley India Publications, 2008
2. Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill, Osborne, 2003.

IV-Year-I Semester	FOG Computing	L	T	P	C
HO4101		3	0	2	4

Course objectives:
This course gives an overview of Fog Computing and its architecture, challenges, and applications in different contexts.

Unit–1: (10 hrs)
Introduction to Fog Computing: Fog Computing, Characteristics, Application Scenarios, Issues, and challenges. Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare, and vehicles. Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.
Unit–2: (9 hrs)
Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures. Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.
Unit–3: (9 hrs)
Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security, and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology, Integrated C2F2T Literature by Modelling Technique by Use-Case Scenarios, Integrated C2F2T Literature by Metrics.
Unit–4: (10 hrs)
Exploiting Fog Computing in Health Monitoring: An Architecture of a Health Monitoring IoT Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components. Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System
Unit–5: (10 hrs)
Software Defined Networking and application in Fog Computing: Open Flow

Protocol, Open Flow Switch, SDN in Fog Computing, Home Network using SDN. Security and Privacy issues: Trust and privacy issues in IoT Network, web Semantics and trust Management for Fog Computing, Machine Learning based security in Fog Computing, Cyber- Physical Energy Systems over Fog Computing.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1 Become familiar with the concepts of Fog

CO2 Understand the architecture and its components and working of components and its
performance.

CO3 Explore Fog on security, multimedia, and smart data

CO4 Model the fog computing scenario.

Text books:

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya.
2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama.
3. Amir Vahid Dastjerdi and Rajkumar Buyya, ―Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne

Reference books:

1. Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, ―Fog Computing and Its Role in the Internet of Things, MCC' 12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978- 1-4503-1519-7/12/08... $15.00.
2. Shanhe Yi, Cheng Li, Qun Li, ―A Survey of Fog Computing: Concepts, Applications, and Issues, Mobidata' 15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China.
3. Amir M. Rahmani, Pasi Liljeberg, Preden, Axel Jantsch, ―Fog Computing in the Internet of Things - Intelligence at the Edge‖, Springer International Publishing, 2018.
4. Ivan Stojmenovic, Sheng Wen, "The Fog Computing Paradigm: Scenarios and Security Issues," Proceedings, Federated Conference on Computer Science and Information Systems, pp. 1–8, 2014.

IV-Year-II Semester	Major Project (Project work, seminar, and internship in industry)	L	T	P	C
PROJ4201		0	0	0	8

- The student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives.
- At the end of the semester the candidate shall submit an internship completion certificate and a project report.
- A student shall also be permitted to submit project report on the work carried out during the internship.
- The project report shall be evaluated with an external examiner.